

Iowa State Implementation Plan for Regional Haze



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Table of Contents

Table of Contents	2
List of Tables and Figures	3
List of Appendices	4
List of Acronyms	5
i. Letter from Director	7
ii. Executive Summary	8
1. Background and Overview of Federal Haze Regulations	9
2. General Planning Provisions.....	12
3. Regional Planning	13
4. State/Tribe and Federal Land Manager Coordination	15
5. Assessment of Baseline, Current, and Natural Conditions in Class I Areas	17
6. Monitoring Strategy.....	21
7. Emissions Inventory Summary.....	23
8. Modeling Assessment.....	26
9. Best Available Retrofit Technology.....	31
10. Reasonable Progress Goals	34
11. Long-term Strategy to Reach Reasonable Progress Goals.....	40
12. Comprehensive Periodic Implementation Plan Revisions.....	56
13. Determination of the Adequacy of the Existing Plan for the Purposes of the Five-Year Progress Report	57
Guidance Documents	58

List of Tables and Figures

Figure 1.1. Map showing the location of the mandatory Class I Federal areas.	11
Figure 1.2. Map identifying areas within 300 km of a mandatory Class I Federal area.	11
Table 3.1. CENRAP states.	13
Figure 3.1. Geographical areas of Regional Planning Organizations.	13
Figure 5.1. Natural background determination.	18
Figure 6.1. Map of CENRAP IMPROVE and IMPROVE Protocol monitoring sites.	22
Table 7.1. 2002 Iowa emissions inventory summary (tons per year).	23
Table 7.2. 2018 Iowa emissions inventory summary (tons per year).	24
Figure 7.1. Comparison of Iowa’s estimated emission rates between the 2002 and 2018 basecase simulations.	25
Table 9.1 Facilities with BART-eligible units in the State of Iowa.	32
Table 11.1. Iowa’s, Minnesota’s, and Michigan’s percent (%) contribution to visibility impairment, as modeled by CENRAP.	41
Table 11.2. Iowa’s absolute contribution to visibility impairment, as modeled by CENRAP.	42
Table 11.3. The estimated 2018 level of visibility impairment in the absence of all Iowa emissions sources.	43
Figure 11.1. Source apportion contributions by region and pollutant to BOWA in 2018.	45
Figure 11.2. Source apportion contributions by region and pollutant to VOYA in 2018.	46
Figure 11.3. Source apportion contributions by region and pollutant to ISLE in 2018.	47
Figure 11.4. Source apportion contributions by region and pollutant to SENE in 2018.	48
Figure 11.5. Comparison of IPM’s 2018 Iowa EGU emissions forecasts.	49
Table 11.4. Iowa’s contributions to visibility impairment as modeled by Minnesota.	50

List of Appendices

- 1.1 Guide to Locating 40 CFR § 51.308 Requirements.
- 1.2 Benefits of Improved Visibility.
- 2.1 Summary of (a) legal authority; (b) public notice and participation process; (c) public notice documents; (d) Iowa Administrative Bulletin for revisions to 567 IAC 22.9; and (e) public comments and responsiveness summary.
- 6.1 Analyses of the Causes of Haze for the Central States (Phase II).
- 7.1 Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans. Prepared for CENRAP by Environ and the University of California at Riverside (UCR), September 12, 2007.
- 8.1 Meteorological Model Performance Evaluation of an Annual 2002 MM5 (version 3.6.3) Simulation. Prepared by Matthew Johnson, Iowa Department of Natural Resources, 2007.
- 8.2 LADCO Nonroad Emissions Inventory Project - Development of Local Data for Construction and Agricultural Equipment, Final Report. E. H. Pechan, September 10, 2004.
- 9.1 Best Available Retrofit Technology Technical Support Documentation.
- 10.1 Description of Interagency Consultation Process in Establishing Reasonable Progress Goals.
- 10.2 Four Factor Report summaries and CENRAP control costs.
- 11.1 Regional Air Quality Analyses for Ozone, PM_{2.5}, and Regional Haze: Technical Support Document. States of Illinois, Indiana, Michigan, Ohio, and Wisconsin. February 15th, 2008.

List of Acronyms

AIRS – Aerometric Information Retrieval System
AQS – EPA’s Air Quality System
BART – Best Available Retrofit Technology
BEEP – Iowa Bus Emission Education Program
Bext – light extinction (typically measured in inverse megameters: $1/\text{Mm}$ or Mm^{-1})
BOWA – Boundary Waters Canoe Area Wilderness
CAA – Clean Air Act 42 United States Code Sections 7401, et seq
CAIR – Clean Air Interstate Rule
CENRAP – Central Regional Air Planning Association
CFR – Code of Federal Regulation
CM – coarse mass (PM_{2.5} mass subtracted from PM₁₀ mass)
CMAQ – Community Multiscale Air Quality model
CAMx – Comprehensive Air quality Model with extensions
DOC – diesel oxidation catalysts
dv – deciview
EGAS5 - Economic Growth Analysis System model version 5
EGU – Electric Generating Unit
EPA – United States Environmental Protection Agency
FLM – Federal Land Manager
FR – Federal Register
GCVTC – Grand Canyon Visibility Transport Commission
IAC – Iowa Administrative Code
IDNR – Iowa Department of Natural Resources
IMPROVE – Interagency Monitoring of Protected Visual Environments
IPM – Integrated Planning Model
ISLE – Isle Royale National Park
LADCO - Lake Michigan Air Directors Consortium
MACT – Maximum Achievable Control Technology
MI - Michigan
MM5 – Fifth-Generation NCAR / Penn State Mesoscale Model
MO – Missouri
MN – Minnesota
MRPO – Midwest Regional Planning Organization
NEEDS – National Electric Energy Data System
NEI – National Emissions Inventory
NO_x – oxides of nitrogen or nitrogen oxides
PM – particulate matter
PM_{2.5} – fine particulate matter; particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers as measured by an EPA–approved reference method
PM₁₀ – coarse particulate matter; particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers as measured by an EPA–approved reference method
POG – CENRAP’s Policy Oversight Group

PSAT – Particulate Matter Source Apportionment Technology
RPG – Reasonable Progress Goal
RAVI - Reasonably Attributable Visibility Impairment
RPO – Regional Planning Organization
SENE – Seney Wilderness Area
SD – South Dakota
SIP – State Implementation Plan
SMOKE – Sparse Matrix Operator Kernel Emissions
SMP – Smoke Management Plan
SO₂ –sulfur dioxide
STN – Speciated Trends Network
TPY – tons per year; also listed as tpy
TSD – Technical Support Document
UCR – University of California at Riverside
USC – United States Code
VIEWS – Visibility Information Exchange Websystem (website)
VISTAS – Visibility Improvement State and Tribal Association of the Southeast
VOC – volatile organic compounds
VOYA – Voyagers National Park

i. Letter from Director

<This page reserved for the SIP transmittal letter.>

ii. Executive Summary

Congress addressed visibility protection at national parks and scenic areas in an amendment to the Clean Air Act in 1977. The Congressional visibility goals were most recently promulgated in the federal Regional Haze Rule on July 1, 1999. The goal of the federal regional haze program is to reach natural background visibility conditions at mandatory Class I Federal areas by 2064.

Iowa does not have a mandatory Class I Federal area. The Boundary Waters Canoe Area Wilderness (MN), Voyageurs National Park (MN), Badlands National Park (SD), Hercules-Glades Wilderness Area (MO), and Mingo Wilderness Area (MO) are the closest Class I areas to Iowa. The pollutants that reduce visibility at these Class I areas include fine particulate matter (PM_{2.5}), and compounds which contribute to its formation, such as nitrogen oxides (NO_x), sulfur dioxide (SO₂), ammonia, and under certain conditions volatile organic compounds (VOCs).

States were required to address visibility impairing pollutant emissions from major source facilities with units constructed between 1962 and 1977. These units, if they met additional requirements, were subject to additional review and possible control. EPA's recommended tools were inappropriate for IDNR given the distances to the Class I areas. IDNR used multiple methods to determine the extent of possible visibility impairment attributable to BART units. IDNR determined that none of the 27 BART units caused or contributed to visibility impairment.

The U.S. Environmental Protection Agency (EPA) created Regional Planning Organizations (RPOs) to facilitate the development of the federally mandated state implementation plans (SIP) across the country. Iowa, as a member state, worked closely with the Central Regional Air Planning Association (CENRAP) to develop this SIP. Through a consultation process, IDNR worked with Missouri, Arkansas, Oklahoma, Minnesota, and Michigan. Emissions sources in Iowa were not found to contribute to visibility impairment in the Class I areas in Missouri, Arkansas, and Oklahoma. Minnesota requested that Iowa review emissions and consider reductions that may affect Minnesota Class I areas.

Based upon results generated through the RPO process, Iowa may contribute to the visibility impairment at Class I areas in Minnesota and Michigan. The most recent EPA forecasts anticipate a decline in Iowa's SO₂ emissions from electrical generating units (EGUs) by approximately 15% between 2002 and 2018. A reduction of 27% is also forecast for EGU NO_x emissions. IDNR has determined that additional reductions are not needed at this time due to existing emissions controls, the projected reductions from recently mandated requirements, and the costs associated with additional controls.

The Regional Haze program requires States to revise the SIP by July 31, 2018, and every ten years thereafter. Federal land managers, with the U.S. Department of Interior and U.S. Department of Agriculture, were given 60 days to review the SIP prior to the public hearing as required in the federal Regional Haze Rule. Progress towards meeting goals is evaluated every five years following the initial SIP submittal. The IDNR will continue to work with industry, the public, and regional partners to evaluate control strategies to address regional haze, as needed.

1. Background and Overview of Federal Haze Regulations

In the 1977 amendments to the Clean Air Act (CAA), Congress added Section 169 (42 U.S.C. 7491) setting forth the following national visibility goal of restoring pristine conditions in national parks and wilderness areas:

“Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from man-made air pollution.”

Over the following years modest steps were taken to address the visibility problems in Class I areas. The control measures taken mainly addressed “Plume Blight” from specific pollution sources, and did little to address regional haze issues in the Eastern United States. Plume blight is the visual impairment of air quality that manifests itself as a coherent plume. This results from specific sources, such as a power plant smoke stack, emitting pollutants into a stable atmosphere. The pollutants are then transported aloft with little or no vertical mixing.

Plume blight is controlled through the reasonably attributable visibility impairment (RAVI) regulations codified at 40 CFR § 51.302. RAVI refers only to visual impairment that results from a single source or a small number of sources. RAVI requirements do not impact Iowa sources as the transport distances are too great for a plume to have retained an applicable level of cohesion upon reaching a Class I area.

When the CAA was amended in 1990, Congress added Section 169B (42 U.S.C. 7492), authorizing further research and regular assessments of the progress made so far. In 1993, the National Academy of Sciences concluded that “current scientific knowledge is adequate and control technologies are available for taking regulatory action to improve and protect visibility.”¹

In addition to authorizing creation of a visibility transport commissions and setting forth their duties, Section 169B(f) of the CAA specifically mandated creation of the Grand Canyon Visibility Transport Commission (GCVTC) to make recommendations to the U.S. Environmental Protection Agency (EPA) for the region affecting the visibility of the GCVTC. Following four years of research and policy development the GCVTC submitted its report to EPA in June 1996. This report, as well as the many research reports prepared by the GCVTC, contributed invaluable information to EPA in its development of the federal Regional Haze Rule.

EPA’s Regional Haze Rule was adopted July 1, 1999, and went into effect on August 30, 1999. The Regional Haze Rule aimed at achieving national visibility goals by 2064. This rulemaking addressed the combined visibility affects of various pollution sources over a wide geographic region. This wide reaching pollution net meant that many states – even those without Class I areas – would be required to participate in haze reduction efforts. EPA designated five Regional

¹ *Protecting Visibility in National Parks and Wilderness Areas*. National Research Council. Washington, DC: 1993.

Planning Organizations (RPOs) to assist with the coordination and cooperation needed to address the visibility issue. Those States and Tribes that make up the midsection of the contiguous United States were designated as the Central Regional Air Planning Association (CENRAP). The State of Iowa is part of CENRAP. The Iowa Department of Natural Resources (IDNR) is the designated air pollution control agency as indicated in section 455B.132 of the Iowa Code.

On May 24, 2002, the U. S. Court of Appeals, D. C. District Court ruled on the challenge brought by the American Corn Growers Association against EPA's Regional Haze Rule of 1999. The Court remanded to EPA the Best Available Retrofit Technology (BART) provisions of the rule, and denied industry's challenge to the haze rule goals of natural visibility and no degradation requirements. EPA published the final revisions to the Regional Haze rule pursuant to the remand on July 6, 2005.

On February 18, 2005, the U.S. Court of Appeals for the District of Columbia Circuit issued another ruling, in *Center for Energy and Economic Development v. EPA*, granting a petition challenging provisions of the Regional Haze Rule governing an optional emissions trading program for certain western States and Tribes. EPA published revised regulations for the provisions of the governing alternative trading programs on October 13, 2006.

To facilitate the review of this State Implementation Plan (SIP) by the EPA, Federal Land Managers (FLMs)¹, stakeholders and the public, "A Guide to Locating 40 CFR § 51.308 Requirements" is provided in Appendix 1.1 of this document.

Some emissions sources within the State of Iowa may have impacts on nearby Class I areas. Figure 1.1 provides a map of all 156 mandatory Class I Federal areas and Figure 1.2 assists with the identification of nearby Class I areas. Combining the effects of distance and relevant transport patterns, nearby Class I areas considered include: Boundary Waters Canoe Area Wilderness (MN), Voyageurs National Park (MN), Isle Royale National Park (MI), Seney Wilderness Area (MI), Badlands National Park (SD), Hercules-Glades Wilderness Area (MO), and Mingo Wilderness Area (MO).

In addition, the IDNR believes that improved visibility will lead to aesthetic and environmental benefits in the affected Class I areas. More information is provided in Appendix 1.2.

List of Chapter 1 Appendices

- 1.1 Guide to Locating 40 CFR § 51.308 Requirements.
- 1.2 Benefits of Improved Visibility.

¹ FLMs include representatives from the National Park Service, U.S. Forest service, and the U.S Fish and Wildlife Service.

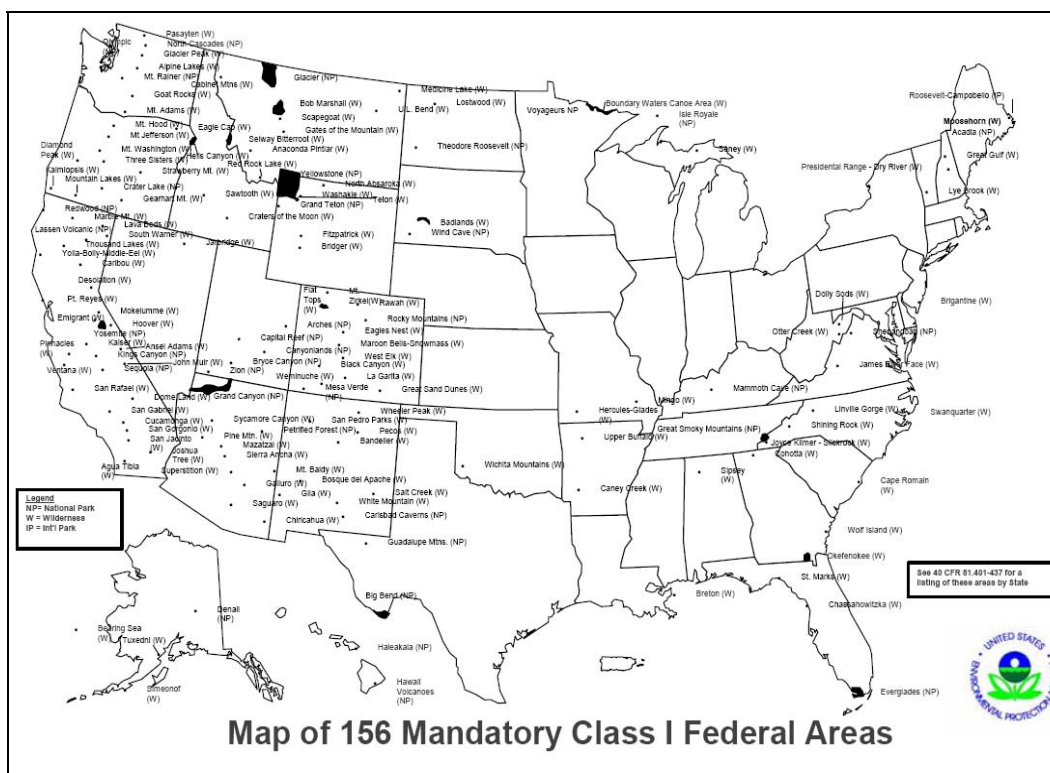


Figure 1.1. Map showing the location of the mandatory Class I Federal areas.

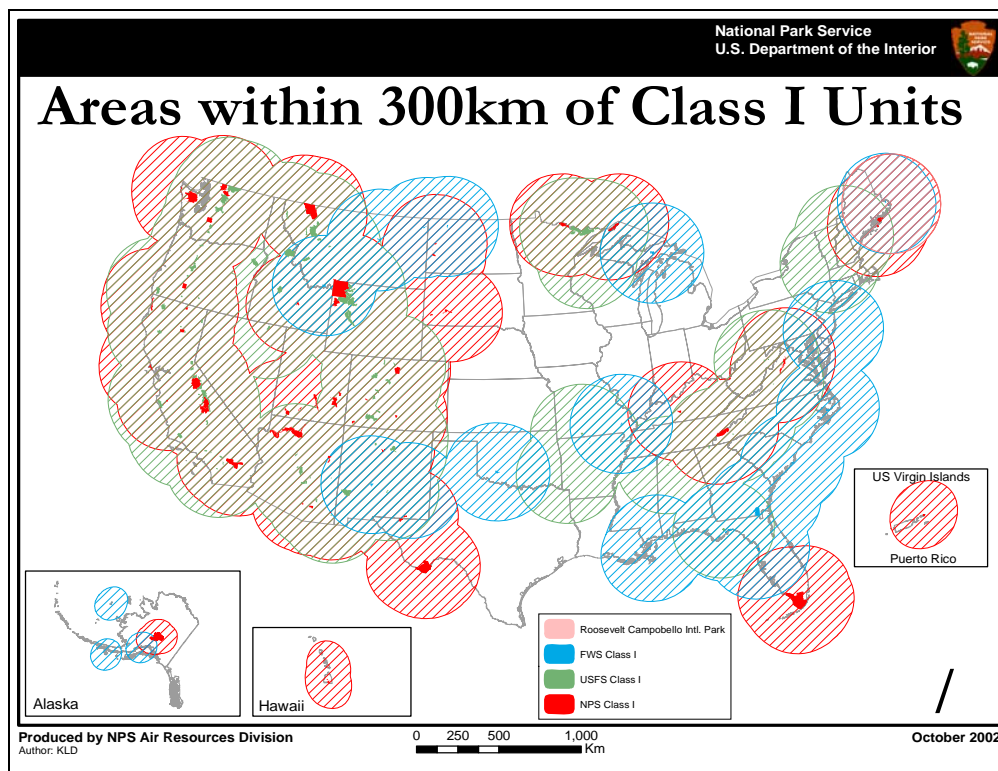


Figure 1.2. Map identifying areas within 300 km of a mandatory Class I Federal area.

2. General Planning Provisions

Pursuant to the requirements of 40 CFR § 51.308(a) and (b), the IDNR submits this SIP revision to meet the requirements of EPA's Regional Haze Rule that were adopted to comply with requirements set forth in the CAA. Elements of this plan address the core requirements pursuant to 40 CFR § 51.308(d) and the Best Available Retrofit Technology (BART) components of 40 CFR § 51.308(e). In addition, this SIP revision addresses Regional Planning, State and FLM coordination, and contains a commitment to provide plan revisions and adequacy determinations.

IDNR has the authority to adopt this SIP revision and has adopted this revision in accordance with State laws and rules. The first portion of IDNR's regional haze rule was adopted into the SIP on September 15, 2005 (70 FR 53939 – 53941). The IDNR provided public notice of the opportunity to comment on the revision to the regional haze rule (567 IAC 22.9) on January 2, 2007. The notice of public hearing was published on January 31, 2007. The public comment period started on January 31, 2007, and ended on March 5, 2007. IDNR held a public hearing regarding the rule revision on March 2, 2007. No comments were received during the public comment period or at the hearing. The rule revisions were approved by IDNR's Environmental Protection Commission on May 1, 2007. The rule revisions were published in the Iowa Administrative Bulletin on May 23, 2007 in ARC 5900B and became effective on June 27, 2007.

The IDNR provided public notice of the opportunity to comment on the SIP revision and the public hearing on December 6, 2007, in the State of Iowa's Public Meeting Calendar, and on December 26, 2007, in the Des Moines Register. IDNR held a public hearing regarding the SIP revision on January 30, 2008. A copy of this report is available at the Iowa Department of Natural Resources – Air Quality Bureau, Records Center, 7900 Hickman Rd, Ste 1, Urbandale, IA 50322, and on our website at www.iowacleanair.com. Public comments, inclusive of those made by the FLMs were addressed and are summarized in Appendix 2.1.

List of Chapter 2 Appendices

- 2.1 Summary of (a) legal authority; (b) public notice and participation process; (c) public notice documents; (d) Iowa Administrative Bulletin for revisions to 567 IAC 22.9; and (e) public comments and responsiveness summary.

3. Regional Planning

In 1999, EPA and affected States/Tribes agreed to create five RPOs to facilitate interagency coordination on Regional Haze SIPs. The IDNR is a member of the Central Regional Air Planning Association (CENRAP) RPO. Members of CENRAP are in the geographical areas listed in Table 3.1. Figure 3.1 shows a map of all five regional planning organizations. The figure covers both state and tribal areas.

Table 3.1. CENRAP states.

Arkansas	Iowa
Kansas	Louisiana
Minnesota	Missouri
Nebraska	Oklahoma
Texas	



Figure 3.1. Geographical areas of Regional Planning Organizations.

The governing body of CENRAP is the Policy Oversight Group (POG). The POG is made up of eighteen (18) voting members representing the states and tribes within the CENRAP region and non-voting members representing local agencies, the EPA, the Fish and Wildlife Service, Forest Service, and National Park Service. The POG facilitates communication with FLMs, stakeholders, the public, and with CENRAP staff.

Since its inception, CENRAP has established an active committee structure to address both technical and non-technical issues related to regional haze. The work of CENRAP is accomplished through five standing workgroups: Monitoring; Emission Inventory; Modeling; Communications; and Implementation and Control Strategies. Participation in workgroups is open to all interested parties. Ad hoc workgroups may be formed by the POG to address specific issues. Ultimately, policy decisions are made by the CENRAP POG.

CENRAP has adopted the approach that the Regional Haze Rule requires the “States to establish goals and emission reduction strategies for improving visibility in all 156 mandatory Class I parks and wilderness areas.” The rule also encouraged states and tribes to work together in regional partnerships.

This SIP revision utilizes data analysis, modeling results, and other technical support documents prepared for regional haze purposes. By coordinating with CENRAP and other RPOs, the IDNR has worked to ensure that its long-term strategy provides sufficient measures to mitigate the impacts of Iowa sources on affected Class I areas. Data analyses, modeling results and other technical support documents developed through CENRAP are provided to members via CENRAP’s website and ftp server.

List of Chapter 3 Appendices

There are no Appendices to Chapter 3.

4. State/Tribe and Federal Land Manager Coordination

Forty CFR § 51.308(i) requires coordination between States and the Federal Land Managers (FLMs). FLMs are an integral part of CENRAP's POG and the membership on standing committees. FLMs have contributed to the development of technical and non technical work as a result of that participation. In addition, opportunities have been provided by CENRAP for FLMs to review and comment on each of the technical documents developed by CENRAP and included in this SIP revision. The IDNR has provided agency contacts to the FLMs as required. In the development of this plan, the FLMs were consulted in accordance with the provisions of 40 CFR § 51.308(i)(2).

The IDNR provided FLMs an opportunity for consultation, in person and at least 60 days prior to holding any public hearing on an implementation plan or plan revision.

During the consultation process, the FLMs review the SIP revision to evaluate:

- Assessment of the impairment of visibility in any Class I areas
- Recommendations on the development of reasonable progress goals (RPGs)
- Recommendations on the development and implementation of strategies to address visibility impairment

IDNR sent the draft SIP revision to the FLMs on November 26th, 2007, and notified the FLMs of the public hearing held on January 30th, 2008. Comments received from the FLMs on the plan were addressed. A summary of FLMs comments and the IDNR's responses to the comments are included in Appendix 2.1 to this plan.

IDNR will continue to coordinate and consult with the FLMs during the development of future progress reports and plan revisions, as well as during the implementation of programs having the potential to contribute to visibility impairment in the mandatory Class I Federal areas. The FLMs must be consulted in the following instances:

- Development and review of implementation plan revisions
- Review of 5-year progress reports
- Development and implementation of other programs that may contribute to impairment of visibility in Class I areas

In addition to the consultation required by 51.308(i), the IDNR has consulted informally with the FLMs individually and through CENRAP during the regional haze SIP development process.

4.1 Continuing Consultation with Federal Land Managers

Forty CFR 51.308(i)(1)(4) requires the development of procedures for continuing consultation between the IDNR and Federal Land Managers on the implementation of the regional haze rule, including plan revisions, five-year progress reports, and on the implementation of other programs which may contribute to visibility impairment at a mandatory Class I Federal area.

The IDNR will continue to utilize the RPOs as the primary mechanism for consultation with the FLMs. The RPOs provided an established mechanism through which formal and informal communication can occur. Consultation is coordinated through the RPOs via conference calls, workgroup activities, meetings, and the facilitation of interagency discussions. Through the RPO process, FLMs will remain active in coordinated activities necessary for development of the five year review. As in the initial regional haze SIP, the FLMs will be provided a 60 day comment period, occurring 60 days prior to any public hearing on any five, or ten, year SIP review or revision.

The Department currently notifies the appropriate FLM in writing of proposed major source or major modifications that may affect a Class I area and requires applicants to submit ambient impact assessments for Class I areas consistent with the Prevention of Significant Deterioration (PSD) regulatory requirements for the review of impacts on Class I areas. This practice will continue in the future.

List of Chapter 4 Appendices

There are no Appendices to Chapter 4.

5. Assessment of Baseline, Current, and Natural Conditions in Class I Areas

The goal of the Regional Haze Rule is to restore natural visibility conditions to the 156 mandatory Class I Federal areas identified in the 1977 Clean Air Act Amendments. Forty CFR § 51.301(q) defines natural conditions: “Natural conditions includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.” The Regional Haze SIPs must contain measures that make “reasonable progress” toward this goal by reducing anthropogenic emissions that cause haze. For each Class I area, there are three metrics of visibility that are part of the determination of reasonable progress:

- 1) baseline conditions,
- 2) current conditions, and
- 3) natural conditions

Each of the three metrics includes the concentration data of the visibility pollutants as different terms in the light extinction algorithm, with respective extinction coefficients and relative humidity factors. Total light extinction, when converted to deciviews (dv), is calculated for the average of the 20 percent best and 20 percent worst visibility days.

“Baseline” visibility is the starting point for the improvement of visibility conditions. It is the average of the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring data for 2000 through 2004 and can be thought of as “current” visibility conditions for this initial period. The comparison of initial baseline conditions to natural visibility conditions indicates the amount of improvement necessary to attain natural visibility by 2064. Natural visibility is determined by estimating the natural concentrations of visibility pollutants and then calculating total light extinction with the light extinction algorithm. (See Figure 5.1 as an example.) Each state must estimate natural visibility levels for Class I areas within its borders in consultation with FLMs and other states (51.308(d)(2)). “Current conditions” are assessed every five years as part of the SIP review where actual progress in reducing visibility impairment is compared to the reductions committed to in the SIP.

Default and refined values for natural visibility conditions

EPA’s “Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program” (Sept 2003) provides States a “default” estimate of natural visibility. The default values of concentrations of visibility pollutants are based on a 1990 National Acid Precipitation Assessment Program report (Trijonis, J.C. (1990) NAPAP State of Science & Technology, vol. III). In the guidance, the United States is divided into “East” and “West” along the western boundary of the states one tier west of the Mississippi River. This division divides the CENRAP states into “East” which includes Arkansas (AR), Iowa (IA), Louisiana (LA), Minnesota (MN), and Missouri (MO) with seven Class I areas, and “West” which includes Kansas (KS), Nebraska (NE), Oklahoma (OK), and Texas (TX) with three Class I areas. In the two classifications, only sulfate and organic carbon have different values, but the calculated deciview difference is significant.

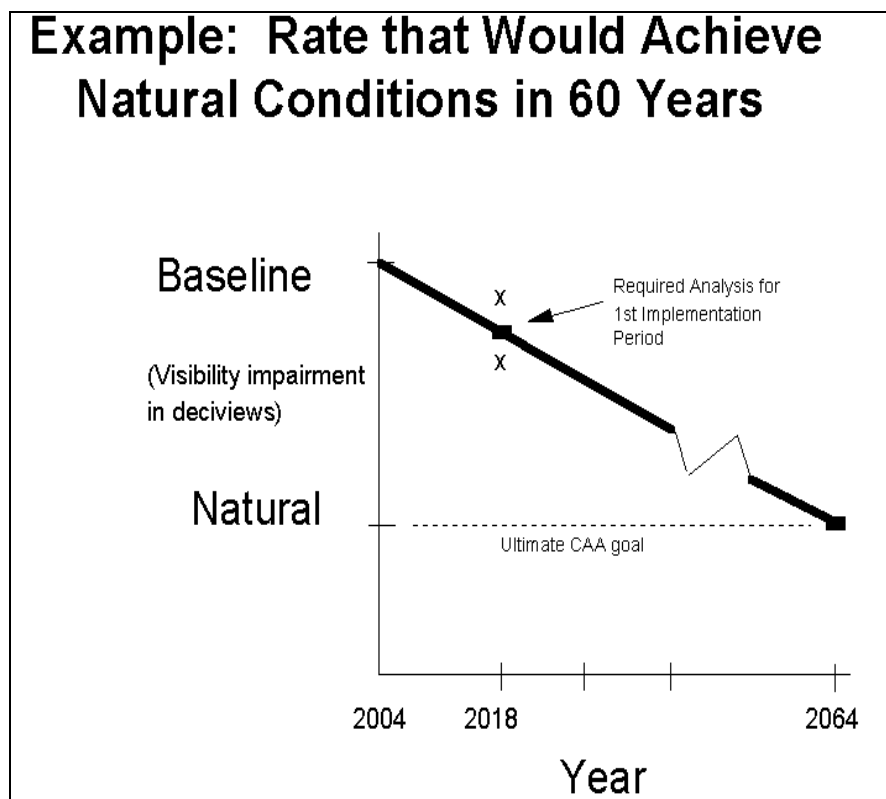


Figure 5.1. Natural background determination.

In the guidance, EPA also provides that states may use a “refined approach” to estimate the values that characterize the natural visibility conditions of the Class I areas. The purpose of refinement would be to provide more accurate estimates with changes to the extinction algorithm that may include: the concentration values; factors to calculate extinction from a measured particular species and particle size; the extinction coefficients for certain compounds; geographical variation (by altitude) of a fixed value; and/or the addition of visibility pollutants. States can choose between the default and refined equations. One equation is used to calculate baseline and current conditions of visibility due to haze-causing pollutants and, with natural concentrations of the same pollutants; the same equation is used to calculate natural visibility.

The old (default) algorithm:

$$\begin{aligned}
 b_{ext} \approx & 3 \times f(RH) \times [\text{Sulfate}] \\
 & + 3 \times f(RH) \times [\text{Nitrate}] \\
 & + 4 \times [\text{Organic Carbon}] \\
 & + 10 \times [\text{Elemental Carbon}] \\
 & + 1 \times [\text{Fine Soil}] \\
 & + 0.6 \times [\text{Coarse Mass}] \\
 & + 10
 \end{aligned}$$

The new (refined) algorithm (differences from the default are in bold):

$$\begin{aligned}
 b_{\text{ext}} \approx & \mathbf{2.2} \times f_s(\text{RH}) \times [\text{Small Sulfate}] + \mathbf{4.8} \times f_L(\text{RH}) \times [\text{Large Sulfate}] \\
 & + \mathbf{2.4} \times f_s(\text{RH}) \times [\text{Small Nitrate}] + \mathbf{5.1} \times f_L(\text{RH}) \times [\text{Large Nitrate}] \\
 & + \mathbf{2.8} \times [\text{Small Organic Mass}] + \mathbf{6.1} \times [\text{Large Organic Mass}] \\
 & + 10 \times [\textit{Elemental Carbon}] \\
 & + 1 \times [\textit{Fine Soil}] \\
 & + \mathbf{1.7} \times f_{\text{ss}}(\text{RH}) \times [\text{Sea Salt}] \\
 & + 0.6 \times [\textit{Coarse Mass}] \\
 & + \text{Rayleigh Scattering (site specific)} \\
 & + \mathbf{0.33} \times [\text{NO}_2 \text{ (ppb)}]
 \end{aligned}$$

[Large Sulfate] = [Total Sulfate] / 20 $\mu\text{g}/\text{m}^3 \times [\text{Total Sulfate}]$, for [Total Sulfate] < 20 $\mu\text{g}/\text{m}^3$

[Large Sulfate] = [Total Sulfate], for [Total Sulfate] \geq 20 $\mu\text{g}/\text{m}^3$

[Small Sulfate] = [Total Sulfate] – [Large Sulfate]

The same equations are used to apportion total nitrate and total organic carbon among their large and small components.

The choice between use of the default or the refined equation for calculating the visibility metrics for each Class I area is made by the state in which the Class I area is located. According to 40 CFR § 51.308(d)(2), the state will make the determinations of baseline and natural visibility conditions. It is with these calculations and in consultation with other states whose emissions affect visibility in that park or wilderness area (40 CFR § 51.308(d)(1)(iv)) that a state develops a RPG for each Class I area located within the state.

Consultation regarding the visibility metrics

Consultation among states is a requirement that is repeated in the Regional Haze Rule. As part of a “long-term strategy” for regional haze, a state whose emissions are “reasonably anticipated” to contribute to impairment in other states’ Class I area(s) must consult with those states; likewise, the state must consult with any states whose emissions affect its own Class I area(s) (40 CFR 51.308(d)(3)).

A chief purpose of the RPO is to provide a means for states to confer on all aspects of the regional haze issue, including consultation on the RPGs and long-term strategies based on the current (baseline) and natural visibility determinations. (This process is described in Chapter 3 “Regional Planning.”) CENRAP has provided a forum for the member States and Tribes to consult on the determination of baseline and natural visibility conditions in each of the Class I areas.

In addition, states in CENRAP have conferred with neighboring Class I area states outside CENRAP, both individually and through the RPOs. IDNR participated on conference calls with

the Northern Midwest Class I Area Consultation Group, which were coordinated by the states of Minnesota and Michigan. Wisconsin, North Dakota, Illinois, FLMs, EPA, CENRAP, Midwest Regional Planning Organization (MRPO), and various Tribes also attended.

The IDNR monitored the activities of the Central Consultation Group. This group was coordinated by the states of Missouri and Arkansas. Other participants include the states of Ohio, Indiana, Illinois, Oklahoma, Texas, Kentucky, Tennessee, FLMs, other RPOs, and tribes. Iowa was determined not to be a contributing State to the central Class I areas of Hercules-Glades, Mingo, Caney Creek, and the Upper Buffalo Wilderness Areas.

IDNR was invited to participate in Oklahoma consultation concerning the Wichita Mountains Wilderness. Oklahoma invited states that had a projected contribution of at least 1 Mm⁻¹ in 2018. Iowa was determined not to be a contributing state to this Class I area.

Forty CFR § 51.308(i) requires that States consult with FLMs, consultation topics include implementation, the assessment of visibility impairment, and recommendations regarding the RPG and strategies for improvement. This consultation requirement is treated in Chapter 4.

The State of Iowa does not contain any Class I areas. The IDNR coordinated with States and Tribes containing Class I areas which are affected by emissions from sources located in Iowa as those States assessed baseline, natural, and current visibility conditions in their respective Class I areas.

List of Chapter 5 Appendices

There are no Appendices to Chapter 5.

6. Monitoring Strategy

The federal Regional Haze Rule requires a monitoring strategy for measuring, characterizing, and reporting regional haze visibility impairment that is representative of all mandatory Class I Federal areas (40 CFR § 51.308(d)(4)).

Upon the creation of CENRAP, the newly formed Monitoring Workgroup recognized that to understand the character of regional haze in CENRAP states, they needed to fill data voids in Southern Arkansas, Iowa, Kansas, Southern Minnesota, Nebraska, and Oklahoma, including monitor placement at locations that were not mandatory Class I Federal areas. Between 2000 and 2003, five new IMPROVE sites and fifteen new IMPROVE Protocol sites were installed in CENRAP. The current network of visibility sites is indicated in Figure 6.1 below.

IDNR currently operates two IMPROVE Protocol sampling sites, one at Viking Lake State Park in southwestern Iowa, and the other at the Lake Sugema Wildlife Management Area in southeastern Iowa. The monitors began operation in June 2002. Additional monitoring equipment located at these two locations provides supplemental information on fine particles and their precursors. Data from IMPROVE and IMPROVE protocol monitors is analyzed by a national laboratory (funded via an interagency agreement between EPA and the National Park Service) and uploaded by the laboratory into two publicly available databases at <http://vista.cira.colostate.edu/improve> and <http://vista.cira.colostate.edu/views/>. The supplemental monitoring data is publicly available at <http://www.epa.gov/ttn/airs/airsaqs>. IDNR intends to continue to operate the two IMPROVE protocol monitors as long as the interagency agreement is in place and funding is available.

In addition to being used for the calculation of baseline visibility conditions, the IMPROVE data (including protocol sites) were analyzed to study the causes of haze within the Central U.S (see Appendix 6.1).

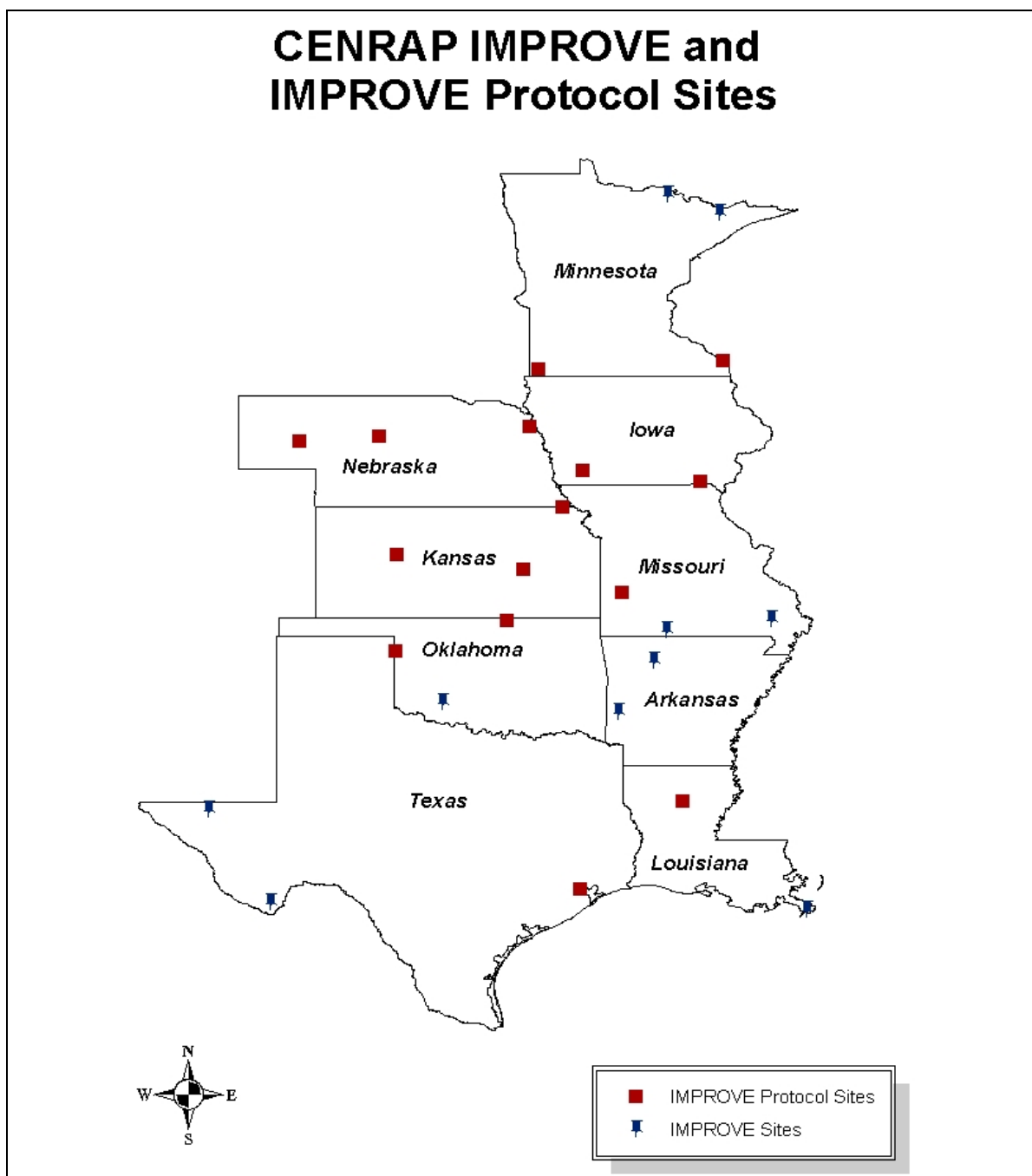


Figure 6.1. Map of CENRAP IMPROVE and IMPROVE Protocol monitoring sites.

List of Chapter 6 Appendices

6.1 Analyses of the Causes of Haze for the Central States (Phase II).

7. Emissions Inventory Summary

2002 Baseline Emissions

The federal Regional Haze Rule requires a statewide emissions inventory of pollutants that are reasonably anticipated to cause, or contribute, to visibility impairment in any mandatory Class I Federal area (40 CFR § 51.308(d)(4)(v)). The pollutants inventoried by the IDNR include species critical for determining visibility impacts such as volatile organic compounds (VOC), nitrogen oxides (NO_x), PM_{2.5}, PM₁₀, ammonia (NH₃), and SO₂. An inventory containing emission rates for all pertinent anthropogenic and biogenic sources was developed for the baseline year 2002. The point source inventory was derived from the 2002 National Emissions Inventory (NEI). The remaining source categories were developed from a variety of data sources and inventory development techniques. A summary of the inventory is provided in Table 7.1. A detailed description of the 2002 emissions inventory is included in Appendix 7.1 (see Chapter 2 of the appendix).

Table 7.1. 2002 Iowa emissions inventory summary (tons per year).

	VOC	NO _x	PM _{2.5}	PM ₁₀	NH ₃	SO ₂
Ammonia	0	0	0	0	258,915	0
Area	106,712	6,782	11,540	12,182	6,560	3,184
Area Fire	1,120	138	4,681	4,893	0	160
Fugitive dust	0	0	38,666	193,331	0	0
Offroad	63,694	92,595	8,904	9,707	79	9,037
Onroad	87,392	120,621	1,747	2,373	3,064	3,200
Point EGU	1,075	81,761	4,527	9,424	0	135,833
Point Fire	545	33	594	700	48	35
Point NonEGU	41,184	35,812	7,651	17,495	3,317	51,836
Road dust	0	0	19,525	127,882	0	0
Wildfire	5	29	218	224	0	8
Biogenic	408,291	25,732				
TOTAL	710,018	363,503	98,053	378,211	271,983	203,293

Future Year Emissions

The 2002 emissions were grown to 2018 by using growth and control factors derived from the EGAS5, MOBILE6, and NONROAD models. The Integrated Planning Model (IPM) was used to forecast 2018 electric generating unit (EGU) emissions. Table 7.2 provides a summary of the 2018 BaseG emissions inventory; a detailed description of the 2018 emissions inventory and the associated growth and control methodologies is included in Appendix 7.1 (see Section 2.13). The summary data provided in Table 7.2 was compiled through a contract with E.H. Pechan.

Table 7.2. 2018 Iowa emissions inventory summary (tons per year).

	VOC	NO _x	PM _{2.5}	PM ₁₀	NH ₃	SO ₂
Ammonia	0	0	0	0	302,012	0
Area	127,849	7,476	10,677	11,510	13,304	3,224
Area Fire	1,120	138	4,681	4,893	0	160
Fugitive dust	0	0	40,608	203,044	0	0
Offroad	37,143	60,210	5,582	6,088	101	220
Onroad	36,404	33,975	708	708	4,225	400
Point EGU	1,802	65,629	9,578	11,232	713	Original: 160,733 Modified: 151,354
Point Fire	547	33	596	702	49	36
Point NonEGU	56,714	40,964	10,151	21,737	5,763	42,862
Road dust	0	0	17,712	114,889	0	0
Wildfire	5	29	218	224	0	8
Biogenic	408,291	25,732				
TOTAL	669,875	234,186	100,511	375,027	326,167	198,264 (Modified)

The 2002 and 2018 point source EGU SO₂ emission rates are 135,833 and 160,733 tons per year (tpy), respectively. The IDNR has serious concerns regarding the 2018 (160,733 tpy) value. CENRAP utilized the ‘RPO version 2.1.9’ IPM (referred to as IPM v2.1.9) predictions to generate the 2018 BaseG scenario, in which total Iowa EGU SO₂ emissions were forecast to be approximately 147,305 tpy. During review of the CENRAP BaseE2 modeling, errors were identified in the 2018 Iowa EGU emissions. Among the errors, certain EGU emissions were double counted when those sources were mistakenly grown through EGAS (as well as IPM). Following error identification, corrections were submitted for inclusion in the BaseF (and subsequent BaseG) modeling scenarios. After the corrections, EGU SO₂ emissions totaled 151,354 tpy. The value of 160,733 tpy provided through the Pechan report is thus known to be inaccurate. Additionally, an EGU SO₂ emission rate of 151,354 tpy is considered unreasonably conservative, given updated results from IPM version 3.0 (discussed in Chapter 11) and Iowa’s participation in the Clean Air Interstate Rule (CAIR) cap and trade program.

Figure 7.1 is provided to aid in the comparison of the 2002 and 2018 estimated emission rates. For chart clarity, only anthropogenic emissions sources are plotted.

The Department does not advocate the use of the 2018 EGU emissions inventory data as incorporated within Table 7.2, or Figure 7.1. As mentioned, the EGU data in Table 7.2 and Figure 7.1 are derived from IPM v2.1.9 predictions. The IPM v2.1.9 forecasts are outdated and based upon faulty inputs and assumptions (additional details regarding EGU forecast data is provided in Chapter 11). Table 7.2 and Figure 7.1 incorporate the IPM v2.1.9 data only to reflect the emissions rates upon which CENRAP modeling is derived. The Department does not endorse the use of IPM v2.1.9 as a source for reasonable 2018 EGU emissions forecasts. The Department considers the IPM v3.0 results an improved estimation of 2018 EGU emission rates, and supports IPM v3.0 as a useful basis for planning purposes.

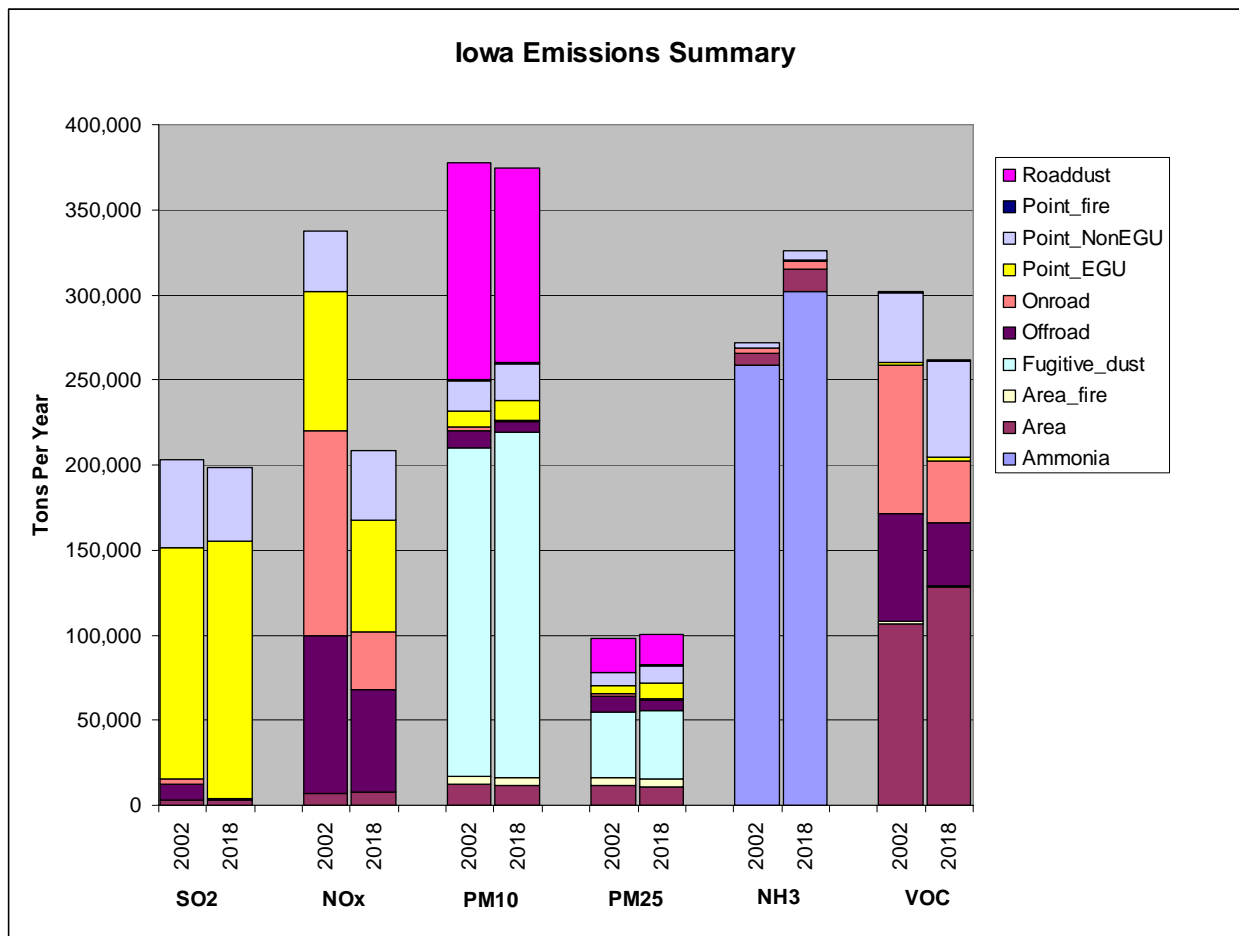


Figure 7.1. Comparison of Iowa's estimated emission rates between the 2002 and 2018 basecase simulations. The modified 2018 EGU SO2 emission rate is plotted.

List of Chapter 7 Appendices

- 7.1 Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans. Prepared for CENRAP by Environ and the University of California at Riverside (UCR), September 12, 2007.

8. Modeling Assessment

Guidelines for conducting regional-scale modeling for particulate matter (PM) and visibility are provided in Appendix W of 40 CFR 51 and EPA's 2007 Modeling Guidance (EPA-454/B-07-002). Within the context of the Regional Haze Rule, EPA recommends the use of sophisticated one-atmosphere photochemical models equipped with state-of-the science mechanisms which simulate the pollutants and pollutant precursors leading to visibility impairment: Two peer reviewed, non-proprietary models capable of meeting such criteria are the Community Multiscale Air Quality (CMAQ) and the Comprehensive Air quality Model with extensions (CAMx). CENRAP contractors have performed regional modeling using both CMAQ and CAMx.

The CMAQ model is a sophisticated Eulerian model that simulates the atmospheric and surface processes affecting the transport, transformation, and deposition of air pollutants and their precursors. An Eulerian model computes the numerical solution on a fixed grid.

CAMx is a computer modeling system for the integrated assessment of photochemical and particulate air pollution. CAMx incorporates all of the technical attributes demanded of state-of-the-science photochemical grid models, including two-way grid nesting, a fast chemistry solver, and an optional subgrid-scale plume-in-grid module to treat the early dispersion and chemistry of point source plumes.

Particulate Matter Modeling: CAMx Mechanism 4 (M4) provides one-atmosphere modeling for fine and coarse PM and ozone. Aqueous phase chemistry is modeled using the RADM mechanism. Inorganic sulfate/nitrate/ammonium chemistry is modeled with ISORROPIA. ISORROPIA is a model that calculates the composition and phase state of an ammonia-sulfate-nitrate-chloride-sodium-water inorganic aerosol in thermodynamic equilibrium with gas phase precursors. Secondary organic aerosols are modeled using a semi-volatile scheme called Simple Object Access Protocol (SOAP). Wet and dry deposition processes are included for gases and particles. Gridded deposition information is output along with the concentrations.

In the July 1, 1999, publication of the Regional Haze Rule in the Federal Register, EPA defined the uses of regional modeling as follows:

- Analyses and determination of the extent of emissions reductions needed from individual states
- Analyses and determination of emissions needed to meet the progress goal for the Class I area
- Analyses to support conclusion that the long-term strategy provides for reasonable progress
- Analyses to calculate the resulting degree of visibility improvement that would be achieved at each Class I area
- Analyses to compare visibility improvement between proposed control strategies

In addition to the analyses listed above, attribution assessments can be completed through implementation of complex tools available within select regional scale photochemical models. For example, the CAMx model includes PM source apportionment technology (PSAT) algorithms which estimate the contributions to visibility impairment at Class I areas by source region (e.g. states) and source category (e.g. point, area, mobile, and biogenic). The implementation of PSAT techniques provides a quantitative measure of the visibility impairment attributable to a given source region or source category. Proper interpretation of PSAT results can assist by providing additional insight into model performance, and can also be used to design efficient control strategies. In development of the regional haze SIP, conclusions drawn from PSAT results are targeted primarily at review of a state's contribution to visibility impairment to a given Class I area.

A summary of the modeling methods, results, and analyses are provided below. Greater detail is contained in Appendix 7.1.

8.1 Model Inputs

8.1.1. Selection of Episodes

Following EPA's draft (2001) and final (2007) Modeling Guidance criteria, a full year was chosen as the modeling episode to ensure adequate inclusion of the various meteorological conditions which produce the best and worst 20% days of visibility impairment at Class I areas. The application of specific episode selection criteria revealed calendar year 2002 to be the ideal temporal distribution. The CENRAP Emissions and Air Quality Modeling Technical Support Document (CENRAP TSD) provides the methodologies for this process and is found at Appendix 7.1 (see Section 1.3.6).

8.1.2. Selection of Modeling Domain

Meteorological and photochemical modeling was conducted on the specifications of the RPO domains. The national RPO domain was initially developed to support a common horizontal and vertical meteorological modeling structure to aid in the simple exchange and utilization of inter-organizational datasets. The basis of the horizontal domain is a Continental United States (CONUS) centric Lambert Conformal Projection centered at 90° W longitude, 40° N latitude, with true latitudes of 33° and 45° N latitude. Additional detail regarding the meteorological modeling domain can be found in Appendix 8.1. The photochemical modeling domain is discussed in Appendix 7.1.

8.1.3. Emissions Inventories

Generating a suitable emissions inventory requires the quantification of all appropriate anthropogenic and biogenic emissions processes within the modeled domain. Each emissions source and the type of pollutants it emits must be specifically identified or suitably represented. General source category classifications include point, area, mobile (on-road and off-road), and biogenics.

The emissions inventory includes VOC, NO_x, CO, SO₂, PM₁₀, PM_{2.5}, and NH₃ emissions from all anthropogenic and biogenic sources. The emissions inventory information submitted by state, tribal, and local agencies to the 2002 NEI formed the basis of the 2002 CENRAP emissions inventory. The NEI data was supplemented with non-point source emissions inventories developed for CENRAP by Sonoma Technology. These CENRAP specific inventories addressed agricultural and prescribed burning, on-road and off-road mobile sources, agricultural tilling and livestock dust, and agricultural ammonia. In addition, Pechan assisted CENRAP by quality-assuring the emissions inventory and preparing day and hour specific emissions for EGUs based on Continuous Emissions Monitor (CEM) data for the model performance evaluation. To increase Iowa's level of consistency between the MRPO and CENRAP emissions inventories, Iowa area NH₃ emissions (focusing upon agricultural sources) were based upon the MRPO data. Further refinement of the Iowa emissions inventory occurred through inclusion of the MRPO BaseK non-road agricultural emissions inventory. The MRPO contracted with Pechan to update and refine aspects of EPA's NONRAOD model, targeting agricultural and construction engine emissions. Details are provided in Appendix 8.2.

Emissions inputs for the air quality model were prepared using the Sparse Matrix Operator Kernel (SMOKE) emissions modeling system. The CENRAP modeling emissions inventory consists of several distinct datasets: the 2002 basecase for model performance evaluation, 2002 typical, 2018 basecase, and the 2018 control strategy scenario. Its spatial extent is the RPO 36 km modeling domain, which covers the continental U.S. plus portions of Canada and Mexico. The inventory was refined through several rounds of CENRAP workgroup review and revision, beginning with the initial BaseA version and culminating in the BaseG inventory. Emissions inventory summary information can be found in Chapter 7. Appendix 7.1 (see Chapter 2) provides the details regarding emissions inventory development.

8.1.4. Meteorology

The Fifth-Generation NCAR / Penn State Mesoscale Model (MM5) is the latest in a series that developed from a mesoscale model used by Anthes at Penn State in the early 70's that was later documented by Anthes and Warner (1978). Since that time, it has undergone many changes designed to broaden its usage. These changes include: multiple-nest capability; nonhydrostatic dynamics, which allows the model to be used at a few-kilometer scale; multitasking capability on shared- and distributed-memory machines; a four-dimensional data-assimilation capability; and expanded physics parameterizations. The model is supported by several auxiliary programs, which are referred to collectively as the MM5 modeling system. Since MM5 is a regional model, it requires initial conditions as well as a lateral boundary conditions. To produce lateral boundary conditions for

a model run, gridded data to cover the entire time period that the model is integrated is needed. Meteorological model configuration and performance details are provided in Appendix 8.1, with additional review contained in Appendix 7.1

8.2 Air Quality Model Performance Evaluation

The CMAQ and CAMx models were spatially and statistically evaluated against ambient measurements of PM species, gas-phase species, and wet deposition in order to qualitatively and quantitatively assess model performance. Monitoring networks available within CENRAP represented in the model evaluation include:

- IMPROVE
- Clean Air Status and Trends Network (CASTNet)
- Speciated Trends Network (STN)
- Aerometric Information Retrieval Systems (AIRS)
- National Atmospheric Deposition Program (NADP)

Emissions modeling, photochemical modeling, and model performance evaluation methods were conducted through an iterative process as errors were identified and subsequently corrected in upstream basecase simulations. Seven major baseline emissions/modeling scenarios were completed, basecases A through G. The final basecase (G) is considered to be more accurate than the preceding versions. Appendix 7.1 (see Chapter 3) contains a detailed model performance evaluation, the summary is provided below.

“In general, the model performance of the CMAQ and CAMx models for sulfate (SO₄) and elemental carbon (EC) was good. Model performance for nitrate (NO₃) was variable, with a summer underestimation and winter overestimation bias. Performance for organic mass carbon (OMC) was also variable, with the inclusion of the SOAmod enhancement in CMAQ Version 4.5 greatly improving the CMAQ summer OMC model performance. Model performance for soil and coarse mass (CM) was generally poor. Part of the poor performance for soil and CM is believed to be due to measurement-model incommensurability. The IMPROVE measured values are due, in part, to local fugitive dust sources that are not captured in the model’s emissions inputs and the 36 km grid resolution is not conducive to modeling localized events.”

8.3 BaseG Model Simulations

The 2018 BaseG modeling run reflects emissions growth and mandated air pollution controls, which are state and federal controls that will be implemented between the 2002 base year and the 2018 future year. The 2018 emissions for EGUs were based on simulations of the IPM that took into account the affects of the CAIR trading program. In addition, reductions anticipated from BART controls for EGUs in Oklahoma, Arkansas, Kansas, and Nebraska were included. Emissions for on-road and off-road mobile sources were based on activity growth and emissions factors from the EPA MOBILE6 and NONROAD models, respectively, which reflected

emissions reductions from the Tier 2 and Tier 4 mobile source rules. Area sources and non-EGU point sources were also grown to 2018 levels.

Future year conditions at Class I areas on the 20% worst and 20% best days were calculated by using results from the 2002 and 2018 CMAQ and CAMx simulations in a relative sense. Relative response factors were calculated to scale the observed PM concentrations from the 2000-2004 baseline conditions (derived from the IMPROVE monitoring network) to obtain the 2018 PM projections. These methods were used in accordance with EPA guidance procedures. Details are provided in Appendix 7.1 (see Chapter 4).

List of Chapter 8 Appendices

- 8.1 Meteorological Model Performance Evaluation of an Annual 2002 MM5 (version 3.6.3) Simulation. Prepared by Matthew Johnson, Iowa Department of Natural Resources, 2007.
- 8.2 LADCO Nonroad Emissions Inventory Project - Development of Local Data for Construction and Agricultural Equipment, Final Report. E. H. Pechan, September 10, 2004.

9. Best Available Retrofit Technology

The U.S. EPA's 1999 Regional Haze Rule singles out for additional controls certain older emissions sources that have not been regulated under other provisions of the Clean Air Act. On July 6, 2005, U.S. EPA published a revised final rule "Guidelines for BART Determinations under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART.

The IDNR has decided not to implement an emissions trading program, or other alternative measure, in place of BART. However, as indicated in Section 9.2, BART-eligible sources that are also subject to the CAIR meet their SO₂ and NO_x BART requirements by participating in the CAIR cap and trade program. The State of Iowa is participating in CAIR, which was adopted in the SIP on August 6th, 2007 (72 FR 43539-43544).

9.1 BART – Eligible Sources in State of Iowa

The facilities with BART-eligible units are shown in Table 9.1. The BART-eligible sources were identified using the methodology in the "Guidelines for BART Determinations under the Regional Haze Rules" or *Guidelines*. To identify BART-eligible emission units, the IDNR used the following *Guidelines* criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on, or after, August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified using the previous two criteria were greater than 250 tons per year of a visibility-impairing pollutant: SO₂, NO_x, VOC, NH₃, or PM.

The *Guidelines* place greater emphasis on the visibility-impairing pollutants: SO₂, NO_x, and particulate matter (PM). The IDNR investigated these three pollutants and also addressed emissions of VOC and NH₃ as part of the BART determination process. Appendix 9.1 contains detailed information on the methods and procedures used to identify BART-eligible sources.

Table 9.1 Facilities with BART-eligible units in the State of Iowa.

Source Category Name	Company Name	Facility Number	BART Emission Units
Fossil Fuel-fired Steam Electric Plant Individually Greater than 250 MMBtu/hour (Electrical Generating Units or EGUs). Please note that these units are subject to the Clean Air Interstate Rule.	Cedar Falls Utilities	07-02-005	Unit #7 (EU10.1A)
	Central Iowa Power Cooperative (CIPCO) – Summit Lake Station	88-01-004	Combustion Turbines (EU 1, EU 1G, EU2, EU2G)
	Central Iowa Power Cooperative (CIPCO) – Fair Station	70-08-003	Unit # 2 (EU 2 & EU 2G)
	City of Ames - Steam Electric Plant	85-01-006	Boiler #7 (EU 2)
	Interstate Power and Light - Burlington	29-01-013	Main Plant Boiler.
	Interstate Power and Light - Lansing	03-03-001	Boiler #4. Sixteen units in total.
	Interstate Power and Light - ML Kapp	23-01-014	Boiler #2. Six units in total.
	Interstate Power and Light - Prairie Creek	57-01-042	Boiler #4. Fourteen units in total.
	MidAmerican Energy Company - Council Bluffs	78-01-026	Boiler #3 (EU003)
	MidAmerican Energy Company - Neal North	97-04-010	Boilers #1-3 (EU001 - EU003)
	MidAmerican Energy Company - Neal South	97-04-011	Boiler #4 (EU003)
	Muscatine Power and Water	70-01-011	Boiler #8
	Pella Municipal Power Plant	63-02-005	Boilers #6-8
Chemical Process Plant	Equistar Chemicals	23-01-004	301 emission units
	Koch Nitrogen Company	94-01-005	Ammonia vapor flares and primary reformer/auxiliary boiler. Eight units in total.
	Monsanto Company Muscatine	70-01-008	Boilers #5-7. Fifty-seven emission units in total.
	Terra Nitrogen Port Neal Comp	97-01-030	Boiler B & Auxiliary Boiler
Petroleum Storage and Transfer Units with a Total Storage Capacity Exceeding 300,000 Barrels	BP - Bettendorf Terminal	82-02-024	Truck loading.
	BP - Des Moines Terminal	77-01-158	Truck loading.
Portland Cement Plant	Holcim (US) Inc.	17-01-009	109 emission units
Fossil Fuel-fired Boiler	ADM	23-01-006	No. 7 & 8 Boilers. These boilers will be permanently shut down by 09/13/2008.
Iron and Steel Mills	Bloomfield Foundry, Inc.	26-01-001	18 emission units
	Griffin Pipe Products Co.	78-01-012	10 emission units
	John Deere Foundry Waterloo	07-01-010	37 emission units
	Keokuk Steel Castings, A Matrix Metals Company LLC	56-01-025	67 emission units
	The Dexter Company	51-01-005	Tumblers 5 & 6.
Secondary Metal Production	Alcoa, Inc.	82-01-002	Hot line mill. Eighty-seven emission units in total.

9.2 Determination of Sources Subject to BART

Under the *Guidelines*, the State has the following options regarding its BART-eligible sources:

a) make BART determinations for all sources, or b) consider exempting some sources from BART because they do not cause or contribute to visibility impairment in a Class I area.

The IDNR has chosen option b. If a State/Tribe chooses option b, the *Guidelines* suggest the following three modeling options for determining which sources may be exempt:

- (1) Individual source attribution approach
- (2) Use of model plants to exempt sources with common characteristics
- (3) Cumulative modeling to show that no sources in a state are subject to BART

The IDNR has chosen sub-option #2 and #3 above to determine which sources are subject to BART. The *Guidelines* established CALPUFF as the preferred air quality model for the BART analysis. IDNR found that CALPUFF inadequately characterizes visibility impacts at the nearby Class I areas due to the extensive transport distances involved. IDNR conducted an approved alternative approach that included Q/d screening methods, emissions inventory scale analyses, CALPUFF model plant analyses, and regional scale one-atmosphere photochemical modeling.

In accordance with the *Guidelines*, a contribution threshold of 0.5 deciview was used for determining which sources were subject to BART. The *Guidelines* provide States the discretion to set a lower deciview threshold than 0.5 deciviews if “the location of a large number of BART-eligible sources within the State and in proximity to a Class I area justifies this approach.” IDNR has determined the 0.5 deciview threshold to be adequate and did not propose alternatives.

IDNR determined that none of the BART-eligible units are subject to BART. Appendix 9.1 contains a detailed discussion of the methods and results which led to this conclusion.

For EGUs, U.S. EPA has found that, as a whole, the CAIR cap and trade program improves visibility more than implementing BART in states affected by CAIR. A State that opts to participate in the CAIR program under 40 CFR 96 AAA-EEE need not require affected BART-eligible EGUs to install, operate, and maintain BART. IDNR accepted EPA’s overall finding that CAIR “substitutes” for BART for EGUs so a BART determination only needed to be completed for PM emissions. The EGU PM emissions were evaluated and the details of the evaluation are in Appendix 9.1.

List of Chapter 9 Appendices

9.1 Best Available Retrofit Technology Technical Support Documentation.

10. Reasonable Progress Goals

The federal Regional Haze Rule requires States and Tribes to establish a Reasonable Progress Goal (RPG) for each Class I area within the state (40 CFR § 51.308(d)(1)). The RPG is measured in deciviews and is to provide for reasonable progress towards achieving natural visibility conditions.

10.1 Reasonable Progress Goals

As indicated earlier, Iowa does not have a Class I area within the state and therefore is not required to establish a RPG. Other states that are required to establish RPGs have made assessments regarding whether emissions sources in Iowa should make emissions reductions to avoid impacting Class I areas within their borders. The consultation process is discussed in Chapters 3, 4, 5, and 11 and in Appendix 10.1.

In addition, EPA released guidance on June 1, 2007 (*Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program*), to use in setting RPGs. Over the first 10 year SIP period, the goals must provide improvement in visibility for the most impaired days, and ensure no degradation in visibility for the least impaired days. A state with a Class I area must also provide an assessment of the number of years it would take to attain natural visibility conditions if improvement continues at the rate represented by the RPG.

The EPA guidance referenced above describes RPGs as follows:

States must establish RPGs, measured in deciviews (dv), for each Class I area for the purpose of improving visibility on the haziest days and ensuring no degradation in visibility on the clearest days over the period of each implementation plan. RPGs are interim goals that represent incremental visibility improvement over time toward the goal of natural background conditions and are developed in consultation with other affected States and Federal Land Managers (FLM). In determining what would constitute reasonable progress, section 169A(g) of the CAA requires States to consider...four factors.

The statutory factors that the state must consider are identified in 40 CFR § 51.308(d)(i)(A) as:

1. The costs of compliance,
2. The time necessary for compliance,
3. The energy and non-air quality environmental impacts of compliance, and
4. The remaining useful life of existing sources that contribute to visibility impairment

In setting a RPG, the above factors are examined within the context of the uniform rate of visibility improvement needed to attain natural conditions by 2064. The state must demonstrate how these factors were taken into consideration in selecting the goal for its mandatory Class I Federal areas.

10.1.1 Four Factor Report

The MRPO and the Minnesota Pollution Control Agency commissioned a report to look at the four factor analysis required by the Regional Haze rule. The report, “Reasonable Progress for Class I Areas in the Northern Midwest – Factor Analysis,” (referred to as the “Four Factor Report”) looked at the factors in a three-state area (Minnesota, Wisconsin, and Michigan) and a nine-state area (Minnesota, Wisconsin, Michigan, Indiana, Illinois, Missouri, Iowa, North Dakota, and South Dakota.). The Four Factor Report primarily looked at controls on EGUs; industrial, commercial, and institutional (ICI) boilers; reciprocating engines and turbines; agricultural sources; and mobile sources. Tables summarizing the nine-state impacts are listed in Appendix 10.2.

10.1.2 Cost of Compliance

The Four Factor Report looked at the cost effectiveness of reducing SO₂ and NO_x emissions using two possible control strategies categorized as EGU1 and EGU2. The EGU1 scenario would cap EGU NO_x emissions at 0.10 lb/MMBtu of fossil fuel consumption and SO₂ would be limited to 0.15 lb/MMBtu of fossil fuel consumption at EGUs. The EGU2 caps are more stringent at 0.07 lb/MMBtu and 0.10 lb/MMBtu of fossil fuel consumption for NO_x and SO₂, respectively. The caps are not enforced at the unit level but represent a proposed region wide average emission rate to be met through a trading program.

The cost of EGU controls, in terms of dollars per ton, provides a limited view of overall effectiveness. A more rigorous review requires the consideration of control costs commensurate with their potential for visibility improvement. Such a measure is achieved by coupling the anticipated visibility impacts of control projects with their associated costs to arrive at a dollar per deciview metric.

While not available for all individual states, the report does quantify dollar per deciview costs across the nine-state region. Examining the EGU1 and EGU2 scenarios, the cost effectiveness for SO₂ ranges from \$2,994,000,000/dv to \$3,336,000,000/dv and NO_x ranges from \$2,332,000,000/dv to \$4,045,000,000/dv for the nine-state region. Expanding this analysis beyond EGU controls, the cost effectiveness of ICI boiler controls is nearly as expensive, ranging from \$2,825,000,000/dv to \$3,397,000,000/dv for SO₂ and from \$2,034,000,000/dv to \$2,473,000,000/dv for NO_x.

By decoupling anticipated visibility impacts, the dollar per ton value discounts the relative effectiveness of potential visibility improvement. The estimated average costs to Iowa EGUs associated with EGU1 (applied in the nine-state region) reach \$1,893/ton for SO₂ control and \$2,359/ton for NO_x. As emission rates are further restricted under EGU2, the costs increase to \$2,074/ton and \$3,580/ton for SO₂ and NO_x controls, respectively. A combination of these two controls produces an average of 1.1 deciview improvement. IDNR does not find this solution to be cost effective for visibility improvement.

The costs provided represent a best estimate based upon supporting information and their accuracy can not be appropriately judged without review of underlying assumptions. As caveated in the report:

“These results do not take into account fuel switching or other secondary impacts, or potential constraints that may exist for installing various control technologies at specific facilities. Thus, they reflect only an estimate of the costs which would be incurred to attain the EGU1 or EGU2 emission reduction targets.”

The costs provided in the report are based upon the IPM v2.1.9 run developed in 2005. Since that time additional EGU control equipment has been permitted in Iowa. These reductions were not forecast by IPM v2.1.9, and as a result costs predicted by IPM v2.1.9 may be underestimated.

In calculating the costs of potential EGU controls IPM incorporates a least cost regression analysis that includes the basic cap and trade restriction associated with CAIR. While the IPM solution is derived from the financial principles of supply and demand economics, model accuracy is restricted by the inherent variability of factors such as the projected needs in the generation, transmission, and consumption of electricity. When predicting the impact CAIR will have upon future EGU conditions, a given IPM solution reflects only one possible scenario. This scenario, including the extent of trading versus controls and associated costs, is unlikely to accurately predict all facility responses.

The IDNR believes it is reasonable to implement CAIR as EPA intended during the first regional haze planning period considering the high costs associated with the additional EGU controls, the extensive distances to Class I areas, and Iowa’s relatively small contributions to visibility impairment.¹ The impact of CAIR can not be fairly addressed until sufficient time has been allowed for program implementation and facility responses. IDNR has adopted EPA’s CAIR cap and trade program and will participate fully in the SO₂, annual NO_x, and ozone season NO_x trading programs. IDNR’s intent is to allow the market forces of the CAIR cap and trade program to drive the installation and operation of cost efficient controls.

IDNR has concluded that additional review of Iowa’s ICI boilers is unwarranted. Costs across the nine-state region, in terms of dollars per deciview, exceed two billion dollars. While state specific dollar per deciview figures are not available, Iowa’s projected 2018 ICI SO₂ and NO_x emissions represent 8.2% and 6.4%, respectively, of the total emissions within the nine-state region. The combination of a low percentage of contributing emissions compounded by the necessary transport distances suggests the above ICI cost estimates would be conservative if calculated for Iowa sources alone. Such costs, in combination with a low potential for discernable visibility improvement, are unreasonable for Iowa sources to incur. Similar arguments apply to other point sources, such as reciprocating engines and combustion turbines.

¹ Contribution assessments are discussed in Chapter 11.

The ICI Boiler NESHAP has recently been vacated. The new federal standards that will be put in place may have additional measures and reductions that the IDNR will incorporate. The revised NESHAP may expand the standard to include more sources. The likely co-benefits of the revised standard will also assist States with their regional haze goals.

Additional cost analyses are available beyond the MRPO/Minnesota Four Factor Report. Alpine Geophysics developed a spreadsheet for CENRAP to look at possible control options and the associated costs. The complete analysis for Iowa sources is in Appendix 10.2. The costs are listed in 2005 dollars. The estimated costs of controls, in combination with a conservative emissions divided by distance screening method, were used to develop and model an emissions reduction scenario as documented in Appendix 7.1 (see Section 4.5). Of the twelve Iowa facilities identified within the screening criteria, all but one were electrical generating units participating in CAIR. Based upon the Alpine Geophysics control costs, implementation in Iowa of the control measures would exceed \$300,000,000 annually. Additionally, Iowa industries have commented that the costs were not accurate. Many stated that the actual cost to control emissions should be nearly doubled. Factors that lead to the difference in cost estimates were the rising costs of concrete, steel, and skilled labor.

Considering the costs and associated caveats, in combination with Iowa's estimated contribution to visibility impairment, these control measures are unreasonable for Iowa sources to incur at this stage of the Regional Haze Rule.

10.1.3 Time necessary for compliance

IDNR determined that additional emission controls are not required based on the cost of compliance. Therefore a timeline or estimated time for compliance is not necessary.

10.1.4 Energy and non-air quality environmental impacts of compliance

The Four Factor Report also demonstrates the energy and non-air quality environmental impacts of controlling emissions. In the nine-state region, carbon dioxide emissions are projected to increase from 3,766,000 tons/year to 5,302,000 tons/year due to the EGU1 and EGU2 controls, respectively.

An additional 1,128,000 – 1,919,000 gallons of wastewater per year is projected to be produced by 2018 in the nine-state region under the EGU1 and EGU2 controls, respectively. The Four Factor Report states that the additional gallons would be treated in existing facilities. Many of Iowa's water treatment facilities are aging and at capacity. The cost of treating the additional wastewater and the likelihood of new facilities increases the costs of compliance.

The nine-state region would incur a projected increase in solid waste production by 2018 of 347,000 – 538,000 tons as part of the EGU1 and EGU2 controls, respectively. That is 20% of the total municipal waste landfill in the State of Iowa in 2006. Iowa's solid waste disposal is organized into 45 planning areas. All waste generated in a planning area must be disposed of in that area. Depending on the remaining capacity of the planning area and other factors, additional landfills may be needed. The process of siting a new landfill can take decades.

10.1.5 Remaining useful life

IDNR determined that additional emission controls are not required based on the cost of compliance. Therefore it is not necessary to determine the remaining useful life of a unit.

10.1.6 Visibility Improvement

Iowa is the state furthest away from Class I areas in the country. All Iowa facilities are separated by at least 300 km from their nearest Class I area. Many of the tools available for visibility analyses are not accurate or appropriate at such distances. CALPUFF, EPA's preferred model for individual source visibility impact assessments, is recommended to be used at 250 km or less. Currently, the best methods for approximating Iowa's impacts upon nearby Class I areas requires implementation of sophisticated apportionment algorithms contained within a select few regional one-atmosphere photochemical models. CENRAP utilized such techniques through implementation of the PSAT tools contained within CAMx.

CENRAP PSAT modeling for 2002 estimated that Iowa contributed 2.4, 2.2, 3.2, and 4.5 Mm^{-1} of the total modeled visibility impairment to the Boundary Waters Canoe Area, Voyageurs National Park, Isle Royale National Park, and Seney Wilderness Area, respectively. In 2018, CENRAP's modeling of on-going mandated air pollution control programs decreases Iowa's contributions slightly, to 2.1, 2.0, 3.0, and 4.0 Mm^{-1} , respectively. These values represent a percentage contribution of approximately 4-5%. Controls installed on Iowa sources may not yield any significant improvement at the Class I areas.

10.2 Consultation

Iowa does not contain any Class I areas, however, IDNR has participated in the consultation process for nearby Class I areas in Minnesota and Michigan. IDNR has also communicated with South Dakota, Wyoming, Missouri, Arkansas, and Oklahoma regarding consultation. Minnesota is in the process of establishing RPGs. IDNR has communicated with Minnesota regarding controls of Iowa sources requested in the Northern Midwest Class I Areas Consultation Conclusion. In correspondence directed to several states, Minnesota requested that further reductions of SO₂ emissions from EGUs be evaluated. Additional requests made by Minnesota can be found in Appendix 10.1 in a copy of the original document. Minnesota's requests were received September 24th, 2007.

In its correspondence with the Department, Minnesota did not request that controls be installed on specific sources. There was no justification on how such controls would lead to visibility improvement at the Minnesota Class I areas. Minnesota has not provided documentation or otherwise consulted with the Department regarding any specific visibility improvement at the Minnesota Class I areas which would result from controlling Iowa sources. Based on the Department's analyses and details provided below in Chapter 11, additional controls and further discussion with Minnesota remains unsupported at this first stage of the regional haze rule. The Department will continue to consult with Minnesota in the future on issues involving regional haze as requested and warranted.

Additional information regarding Iowa's involvement in regional haze consultation processes is provided in Appendix 10.1

10.3 Reporting

Progress will be reported to the EPA every five years in accordance with 40 CFR § 51.308 (g).

List of Chapter 10 Appendices

- 10.1 Description of Interagency Consultation Process in Establishing Reasonable Progress Goals.
- 10.2 Four Factor Report summaries and CENRAP control costs.

11. Long-term Strategy to Reach Reasonable Progress Goals

The IDNR is required to submit a long-term strategy (40 CFR § 51.308(d)(3)) that addresses regional haze visibility impairment for each mandatory Class I Federal area outside the State which may be affected by emissions from within the State. The long-term strategy must include enforceable emissions limitations, compliance schedules and other measures necessary to achieve the reasonable progress goals (RPGs) established by States and Tribes where the Class I areas are located.

When coordinated with other State and Tribe strategies, IDNR's long-term strategy is sufficient to meet anticipated RPGs for states containing Class I areas which may be affected by emissions from Iowa sources. Since Iowa does not have a Class I area, the IDNR is not required to establish a RPG. The absence of a Class I area does not exempt IDNR from developing a long-term strategy. A long-term strategy is required to address those emissions which may contribute to visibility impairment at a Class I area.

Emissions from Iowa sources may contribute to visibility impairment at the following Class I areas: Boundary Waters Canoe Area Wilderness (MN), Voyageurs National Park (MN), Seney Wilderness Area (MI), and Isle Royale National Park (MI). Collectively, these Class I areas are commonly referred to as the Northern Midwest Class I areas. The remainder of this chapter discusses IDNR's long-term strategy in detail and describes how the IDNR meets the long-term strategy requirements associated with the Northern Midwest Class I areas.

11.1 Consultation

IDNR is required to consult with other States and Tribes to develop coordinated emission strategies (40 CFR § 51.308(d)(3)(i)). This requirement applies where emissions from the State are reasonably anticipated to contribute to visibility impairment in Class I areas outside the State.

IDNR consulted with other States and Tribes by participation in the CENRAP and MRPO processes that developed technical information necessary for development of coordinated strategies. In addition, IDNR participated in discussions focused on Class I areas in the Northern Midwest which involved the following states and tribes: Minnesota, Michigan, Wisconsin, North Dakota, Illinois, Missouri, Bois Forte Reservation, Fond du Lac Reservation, Forest County Potawatomi, Grand Portage Band of Chippewa, Leech Lake Band of Ojibwe, Mille Lacs Band of Ojibwe, and Upper/Lower Sioux Communities. Federal land managers were active participants in this sub-regional consultation process as well. IDNR also coordinated with CENRAP and other RPOs to develop supporting documentation (Appendix 7.1) that was used to develop the State's long-term strategy. Long-term strategy development considered the impacts of Iowa's emissions on Class I areas outside the State.

Consultation with the FLMs is a separate requirement beyond the scope of 40 CFR § 51.308(d)(3)(i)). IDNR's long-term strategy development was reviewed by the FLMs as described in Chapter 4.

11.2 Contributions to Visibility Impairment

Where emissions in Iowa contribute to visibility impairment at a mandatory Class I Federal area, IDNR must demonstrate that its implementation plan includes all measures necessary to obtain its share of emission reductions needed to meet the RPG for the area (40 CFR § 51.308(d)(3)(ii)). IDNR fulfills this requirement through compliance with existing mandatory air pollution control programs. Participation in the Clean Air Interstate Rule (CAIR) cap and trade program is a critical component in this determination. Through CAIR, Iowa electrical generating units (EGUs) are anticipated to reduce not only ozone season NO_x emissions, but annual emissions of SO₂ and NO_x. The IDNR has relied upon modeling results, source apportionment techniques, data analysis, and weight of evidence measures to assert these conclusions. A discussion of the supporting procedures and results follows.

Iowa's Cumulative Visibility Impacts

Particulate matter source apportionment technology (PSAT) modeling techniques were used by CENRAP to investigate which states contribute to visibility impairment at a Class I area. Source apportionment results are an effective tool for assessing state contributions as they assist in quantifying the amount of visibility impairment attributable to a particular state.

According to the CENRAP PSAT results, the combined effect of all Iowa emissions upon the total modeled¹ visibility impairment at the four Northern Midwest Class I is approximately 4-5% in both 2002 and 2018. These results² are shown in Table 11.1. The data were calculated in accordance with the new IMPROVE equation and are representative of those days which yielded the worst 20% visibility conditions. A detailed description of the source apportionment methods utilized by CENRAP is available in Appendix 7.1 (see Section 5.4).

Table 11.1. Iowa's, Minnesota's, and Michigan's percent (%) contribution to visibility impairment, as modeled by CENRAP.

Site	Iowa			Minnesota			Michigan	
	2002	2018		2002	2018		2002	2018
BOWA	3.7	3.9		25.6	28.5		2.3	2.7
VOYA	3.8	4.0		29.1	30.4		1.4	1.6
ISLE	4.5	4.9		11.5	12.5		11.1	12.8
SENE	4.2	4.8		3.9	4.4		9.6	12.7

The PSAT results provided above are in terms of percentages of total visibility impairment and are useful for determining the proportion of a States' contribution in relation to the total modeled visibility impairment at a Class I area. Characterizing visibility impairment using percentages fails to identify the magnitude of the contribution. For example, Iowa's contributions, on a percentage basis, increase between 2002 and 2018. However, the actual light extinction values

¹ Total modeled visibility impairment does not include Rayleigh scattering. The inclusion of Rayleigh scattering is only necessary when calculating deciview values. Deciview calculations require a Class I area's total visibility impairment (i.e. modeled visibility impairment plus Rayleigh scattering).

² Percentages were obtained from the August 27, 2007, version of Environ's source apportionment tool.

decrease. Similar results occur for many other States. Table 11.1 demonstrates that both Minnesota and Michigan see an increase in their contributions to visibility impairment, in terms of percentage contribution, between 2002 and 2018. The data in Table 11.1 yields an additional perspective in terms of a contribution analysis. Minnesota sources are responsible for approximately 7 times as much apportioned visibility impairment as are Iowa sources at BOWA and VOYA.

Iowa's contributions to visibility impairment, as calculated through light extinction constructed using the new IMPROVE equation, are provided in Table 11.2. The total modeled visibility impairment for each Class I area are also shown in Table 11.2.

Table 11.2. Iowa's absolute contribution to visibility impairment, as modeled by CENRAP.

Site	Worst 20% Days Modeled Extinction (Mm ⁻¹)			
	Iowa		Class I Area Total	
	2002	2018	2002	2018
BOWA	2.39	2.08	64.87	53.44
VOYA	2.16	1.97	56.45	48.84
ISLE	3.23	3.02	71.40	61.26
SENE	4.54	3.95	107.92	82.00

Iowa emissions sources cumulatively contribute only 2.2 - 4.5 Mm⁻¹ of the 56 - 107 Mm⁻¹ total modeled visibility impairment at the Northern Midwest Class I areas in 2002. In tandem, Iowa's percentage and absolute contributions describe the impacts emissions sources in Iowa have upon nearby Class I areas. Collectively, Iowa sources are responsible for a minimal contribution to visibility impairment at the Northern Midwest Class I area, and offer little in terms of potential visibility improvement.

An alternative means of assessing Iowa's contribution to visibility impairment can be conducted through implementation of the deciview metric. A deciview is defined in 40 CFR §51.301 as "a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired." A change in visibility impairment of one deciview is theoretically the minimum level detectable by a human observer. Calculations with the deciview metric reveal that the elimination of all Iowa emissions sources may not yield a perceptible improvement in visibility.

The 2018 Class I area total modeled extinction values provided in Table 11.2 are easily converted into a deciview value (as the total modeled extinction values do not include Rayleigh scattering affects, a value of 10 Mm⁻¹ has been assumed for illustrative purposes). For each Class I area the level of visibility impairment which may result in the absence of all Iowa emissions sources is provided in Table 11.3. This calculation is completed by subtracting the visibility extinction attributable to Iowa sources from the Class I area total, and converting the

result into a deciview value. The difference between the two deciview values provides a representation of Iowa's impacts in terms of perceptible visibility improvement.

Table 11.3. The estimated 2018 level of visibility impairment in the absence of all Iowa emissions sources.

Site	2018 Worst 20% (dv)	2018 Worst 20% Less Iowa's Contribution (dv)	Iowa's Visibility Impacts (dv)
BOWA	18.5	18.1	0.4
VOYA	17.7	17.4	0.3
ISLE	19.6	19.2	0.4
SENE	22.2	21.8	0.4

Visibility improvements resulting from the elimination of all Iowa sources yields impacts below one deciview. Based on this analysis Iowa's modeled 2018 contributions are imperceptible by a human observer. However, the elimination of all Iowa sources would alter the atmospheric chemistry from which the deciview metrics in Table 11.3 are derived. This caveat places a limit on the numerical accuracy of the results. The uncertainty does not alter the conclusion that the estimated 2018 emissions originating within Iowa have a minimal impact upon visibility impairment in the Northern Midwest Class I areas.

Comparing Impacts from Midwestern States

The above results focus solely upon contributions attributable to Iowa sources. A more complete review of visibility impairment requires comparing Iowa's contributions in relation to nearby states, including the states containing a Class I area. Evaluating Iowa's impacts in this relative sense further clarifies Iowa's minimal level of contribution.

The PSAT results allow a given state's total contribution to be partitioned among specific species. The PSAT results support previous conclusions identifying SO₂ and NO_x emissions as critical components to regional haze (e.g. see Appendix 6.1, the Causes of Haze (Phase II) report).

The charts provided below (Figures 11.1 - 11.4) are based upon the CENRAP 2018 source apportionment modeling. The data are ordered according to rank, with contributions decreasing by region¹ from left to right. Contributions are provided in terms of light extinction values (based on the new IMPROVE equation, see Chapter 5 for additional information on extinction metrics). While 2002 basecase results are available, only the 2018 results take into account changes in future year emissions effected by mandated air pollution control programs.

¹ The term region is used, instead of state, as the PSAT methods tracked not only state contributions, but also tracked additional areas, such as Canadian and Mexican contributions. To reduce computational resources, distant western and eastern states' contributions were not tracked individually, but were grouped into East and West regions. See Appendix 7.1 (Section 5.4) for additional detail.

Iowa's 2.08 Mm^{-1} contribution to the 2018 total modeled visibility impairment at BOWA ranked 7th overall when considering all regions. Examining state contributions only, Iowa contributions ranked 5th (with the Canadian and boundary regions having greater contributions). As expected, Minnesota sources lead state contributions, with Wisconsin, North Dakota, and Illinois having greater contributions than Iowa. These results are depicted in Figure 11.1. The importance of sulfur and nitrogen compounds as a leading cause of regional haze is also shown in this figure, as most state contributions are apportioned among sulfates (shown in yellow) or nitrates (shown in red).

Looking at state contributions only (ignoring Canadian, Western states', and boundary condition contributions) Iowa ranks 4th at Voyageurs National Park. Again, Minnesota dominates the contribution assessment, with North Dakota and Wisconsin sources also contributing more to visibility impairment than Iowa sources. These results are depicted in Figure 11.2.

Emissions sources within Michigan are the leading cause of visibility impairment at ISLE and SENE, as shown in Figures 11.3 and 11.4. Emissions within nearby states are responsible for a greater degree of visibility impairment than emissions sources within Iowa. At ISLE, Iowa ranks 5th among state contributions to visibility impairment in 2018, with a modeled contribution of 3.02 Mm^{-1} . Emissions within Michigan, Wisconsin, Minnesota, and Illinois yield greater impacts than Iowa sources. Within SENE, Iowa contributions are 3.95 Mm^{-1} , which ranks 6th among States, below the contributions attributable to Michigan, Illinois, Wisconsin, Indiana, and Missouri.

In summary, Iowa's cumulative emissions have a much smaller impact upon the Northern Midwest Class I areas than many other states. Where emissions from Iowa sources do have quantifiable impacts, SO₂ and NO_x emissions are primarily responsible.

EGU Impacts

Based upon emissions inventory analyses and PSAT results from the MRPO, Iowa EGU SO₂ emissions are primarily responsible for the visibility impairment attributable to SO₂ emissions from Iowa (see Appendix 11.1). Iowa EGU's also contribute approximately one fourth of Iowa's total NO_x emissions. Generating a skillful 2018 inventory of EGU SO₂ and NO_x emissions is important.

The Integrated Planning Model (IPM) is a tool used to estimate the 2018 EGU emissions of SO₂ and NO_x. IPM provides a prediction of EGU controls in response to CAIR. An accurate IPM forecast is necessary to develop reliable predictions of visibility impairment. However, the CENRAP modeling used an outdated version of IPM which over predicted the emissions of SO₂ from Iowa EGUs. This likely led to an over prediction of Iowa's 2018 contributions to visibility impairment at the Northern Midwest Class I areas. A more recent IPM version was available, but was not used by CENRAP. The EGU emissions reductions forecast by the new IPM version achieve Iowa's share of emissions reductions, as required by 40 CFR § 51.308(d)(3)(ii).

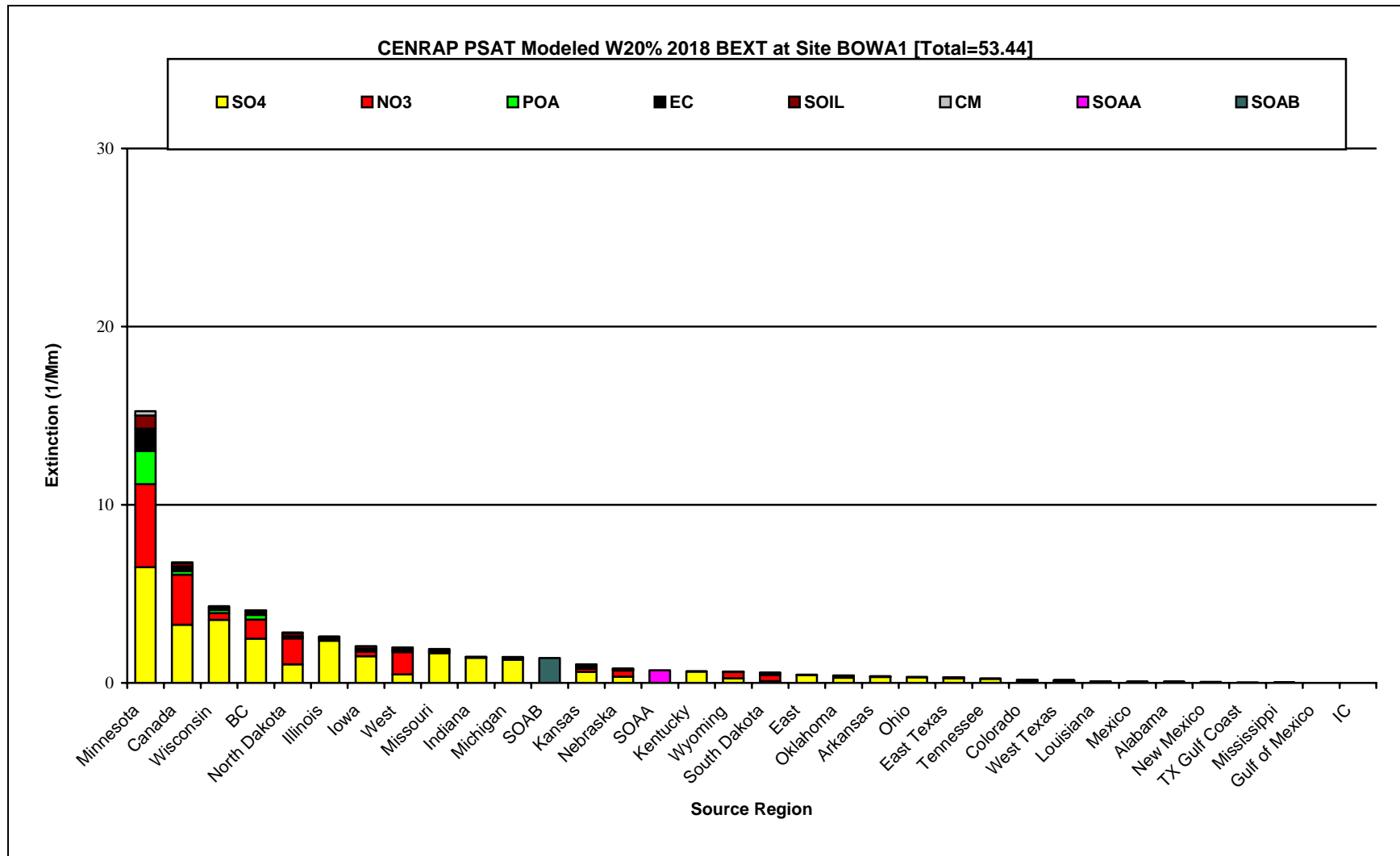


Figure 11.1. Source apportion contributions by region and pollutant to BOWA in 2018.

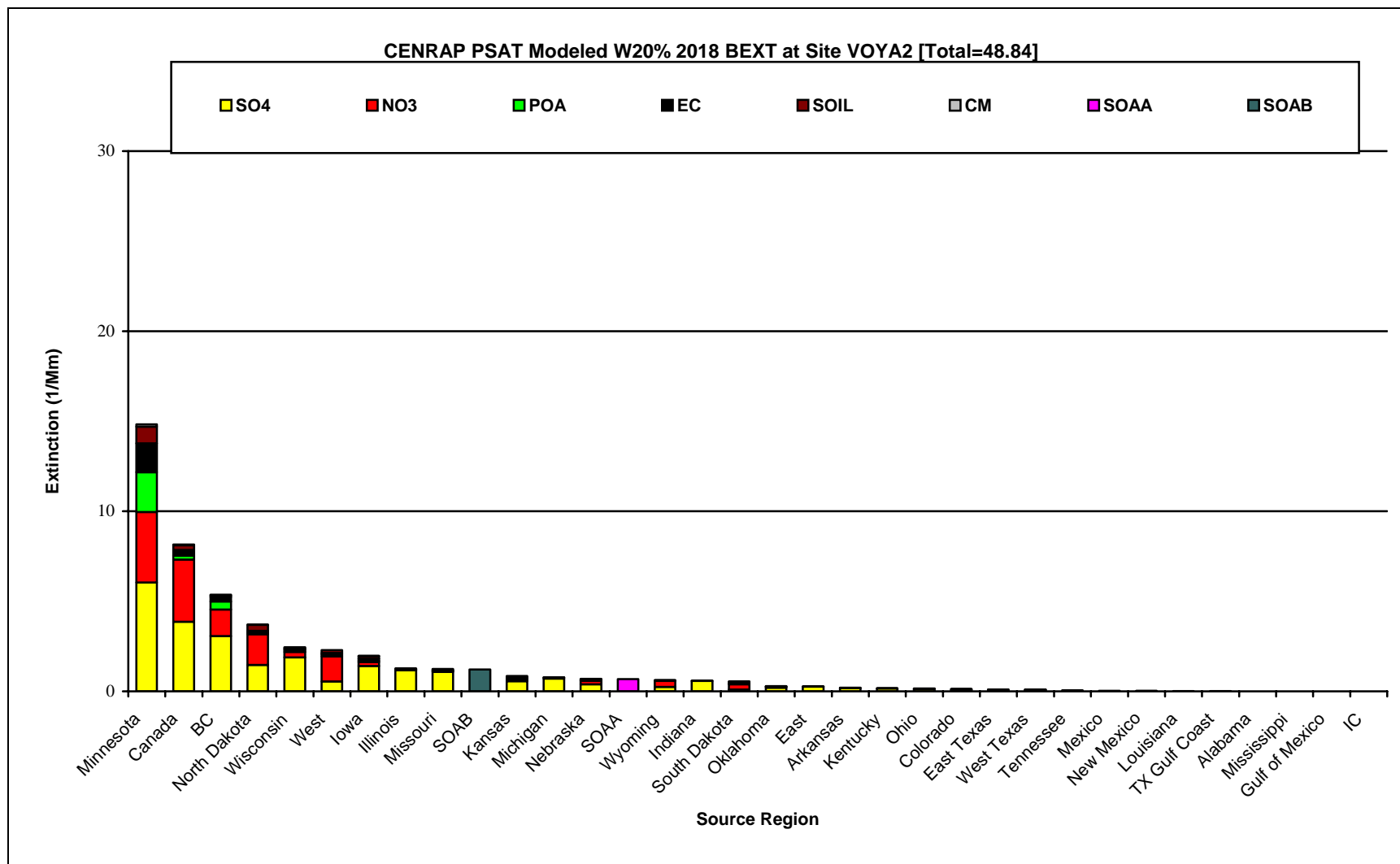


Figure 11.2. Source apportion contributions by region and pollutant to VOYA in 2018.

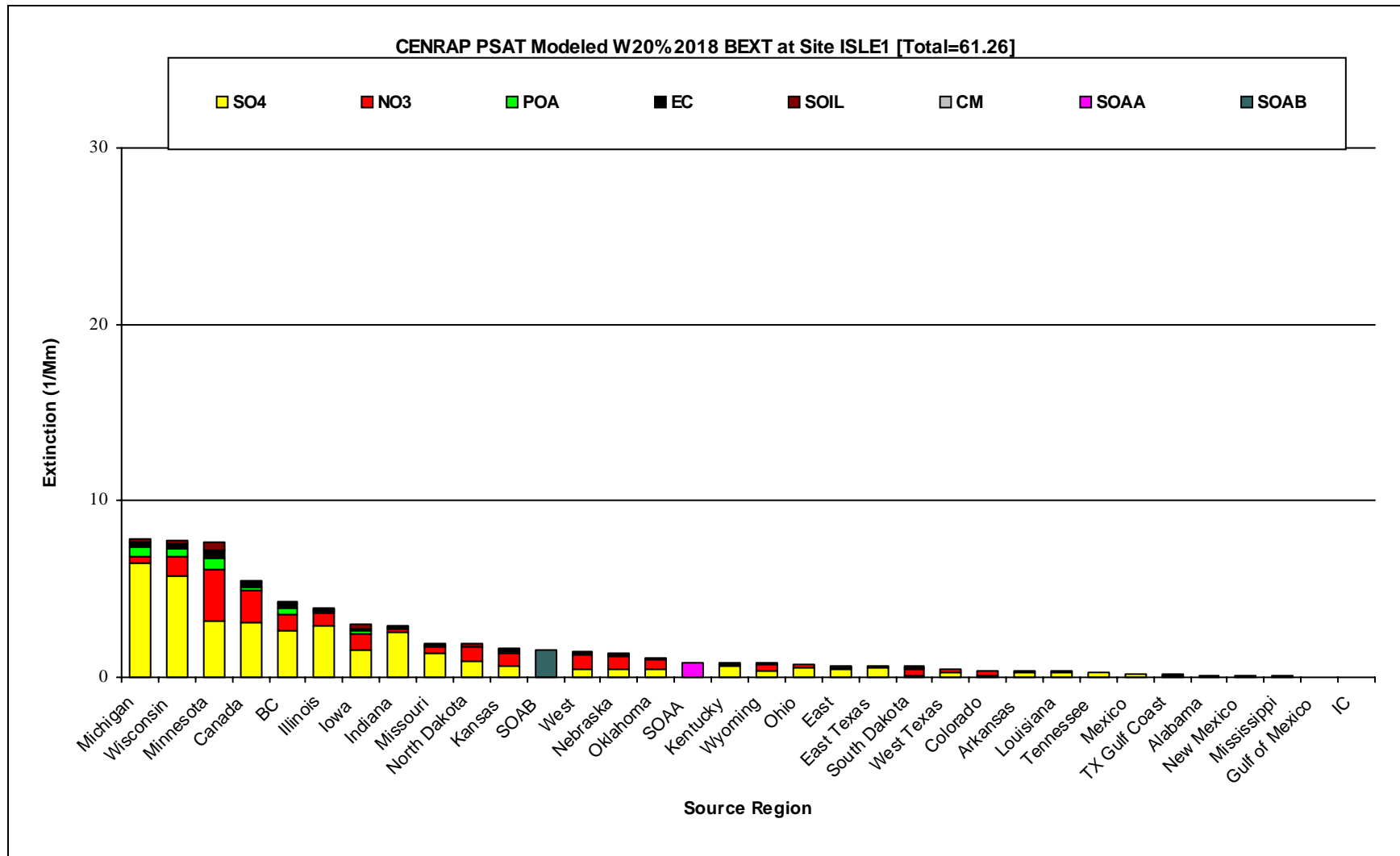


Figure 11.3. Source apportion contributions by region and pollutant to ISLE in 2018.

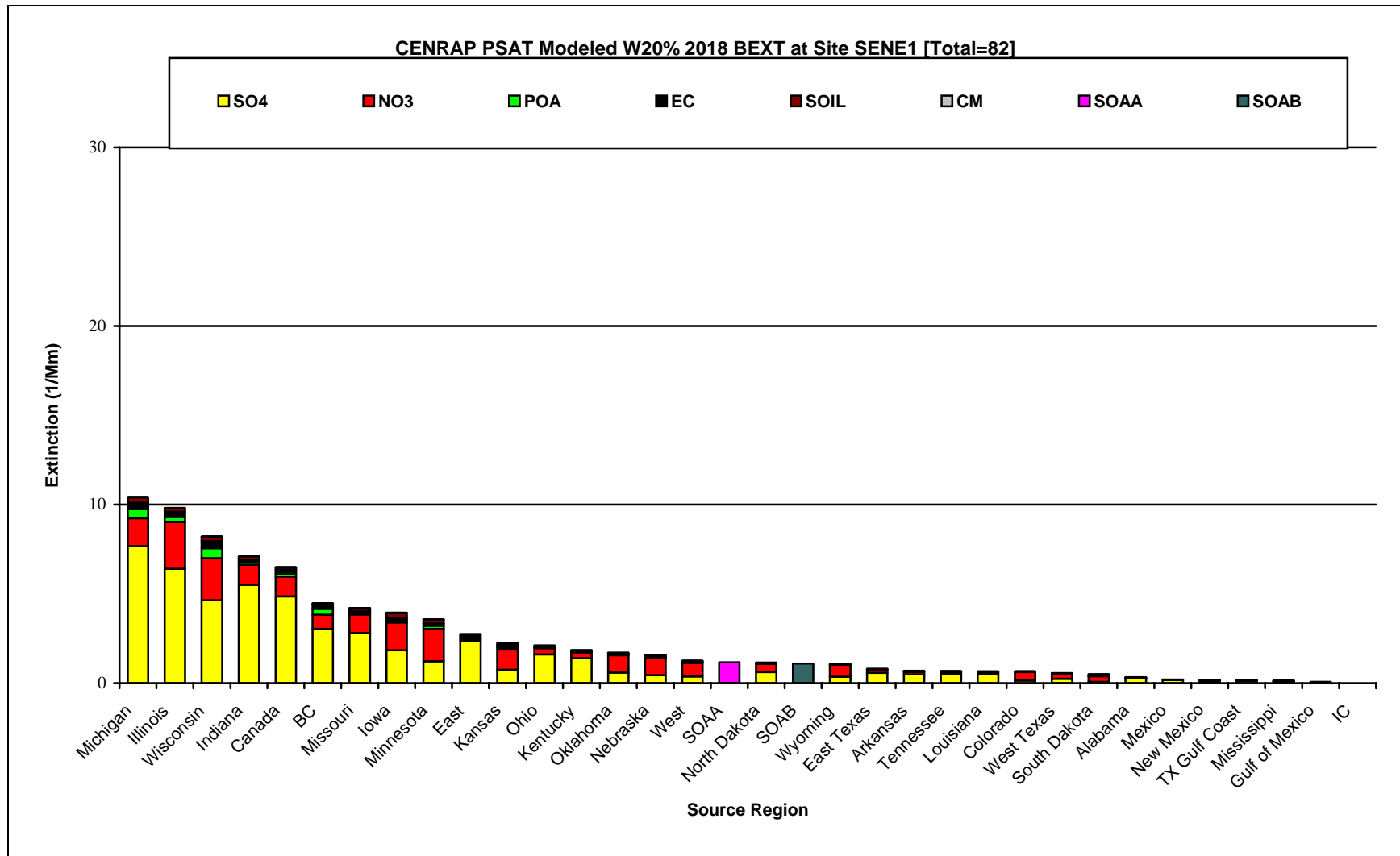


Figure 11.4. Source apportion contributions by region and pollutant to SENE in 2018.

Updates to EGU Emissions Forecasts

CENRAP utilized the 'RPO version 2.1.9' IPM forecasts (referred to as IPM v2.1.9) to create the 2018 BaseG emissions scenarios. IPM v2.1.9 was generated in the 2004-2005 timeframe using the information available at the time. More recent IPM forecasts, generated during the 2006-2007 timeframe, are now available. The updated 2018 projections utilized the latest IPM source code (version 3.0, referred to as IPM v3.0) and incorporated updated fuel costs and recent regulatory impacts. The IPM v3.0 results also reflect updates made by the IDNR to the National Electric Energy Data System (NEEDS) model input database. These improvements included updated permit conditions reflecting the addition of SO₂ and NO_x controls. The IPM v3.0 results also incorporate minor stack parameter error corrections not captured in IPM v2.1.9. Both EPA and IDNR therefore consider the IPM v3.0 results to be technically superior to those of IPM v2.1.9.

Based upon IDNR's updates and error corrections, in combination with all other improvements, IPM v3.0 results differ significantly from the EGU forecasts used within the CENRAP modeling. Figure 11.5 provides a comparison between the two versions of IPM. For reference, Iowa's 2002 basecase emissions are also shown. The IPM data plotted in Figure 11.5 reflect only unmodified results, thus IPM v2.1.9 values differ from the EGU emission rates provided in Table 7.2. Sulfur dioxide emission rates forecasted by IPM v2.1.9 increase above 2002 levels, in spite of IDNR's participation in the CAIR SO₂ cap and trade program. The IPM v3.0 results yield a 15 percent reduction in SO₂ emissions versus 2002 conditions. While the NO_x emissions reductions predicted by IPM v3.0 are not as great as the v2.1.9 results, a reduction of 27% is still forecast. Considering the level of visibility impairment attributable to Iowa sources, the SO₂ and NO_x reductions associated with participation in the CAIR cap and trade program are sufficient to achieve Iowa's share of emissions reductions.

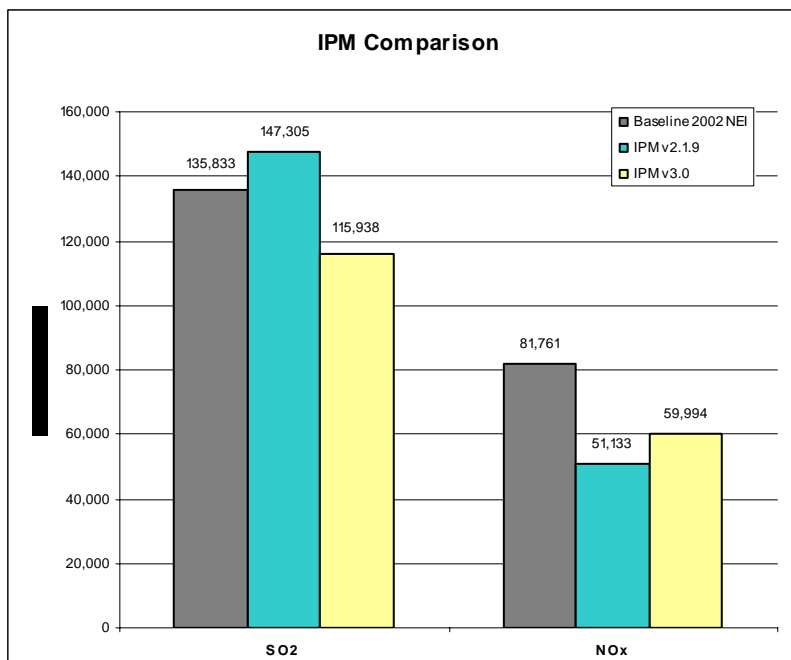


Figure 11.5. Comparison of IPM's 2018 Iowa EGU emissions forecasts.

11.3 Minnesota/MRPO Modeling Results

The IDNR is utilizing source apportionment modeling data provided by Minnesota in a weight of evidence¹ approach to support IDNR's conclusion that CAIR achieves Iowa EGU SO₂ and NO_x reductions appropriate to Iowa's level of visibility contributions at the Northern Midwest Class I areas.

The Minnesota modeling is based upon the 2002/2018 BaseK work completed by the MRPO.² Unlike previous 2018 BaseK simulations, the Minnesota/MRPO modeling included EGU forecasts derived from IPM v3.0. Instead of using the default IPM v3.0 results, Minnesota and the MRPO States modified the IPM v3.0 results to reflect known EGU emissions modifications occurring prior to 2018, but not captured within the original IPM v3.0 simulation. This EGU forecast is referred to as the 'IPM3.0-Will-Do' scenario. No Iowa EGU emission rates were adjusted within the 'IPM3.0-Will-Do' scenario.

An overview of both the 2002 basecase and 2018 Minnesota/MRPO source apportionment modeling is provided in Table 11.4. Specifically listed are the visibility impacts attributable to Iowa sources. Data are provided in terms of an absolute extinction value (calculated using the new IMPROVE equation), and are generally comparable to the data in Table 11.2. The Minnesota/MRPO PSAT modeling examines only sulfate, nitrate, and ammonium partitioning, thus state apportionments of primary species (such as primary organic aerosol, fine primary particulate, primary coarse particulate, and elemental carbon) can not be incorporated into the totals provided in Table 11.4. Values calculated through CENRAP results (Table 11.2 for example) reflect the contributions from primary species. In terms of Iowa's contribution to the Northern Midwest Class I areas, the exclusion of primary species source apportionment techniques has negligible impacts as sulfate, nitrate, and ammonium are the dominant species. For states and regions closer to the Class I areas these species can increase in importance, particularly primary organic aerosol. Sulfates and nitrates currently remain the dominant species under consideration.

Table 11.4. Iowa's contributions to visibility impairment as modeled by Minnesota.

Site	Worst 20% Days Modeled Extinction (Mm ⁻¹)	
	2002	2018
BOWA	2.48	2.40
VOYA	2.10	2.11
ISLE	3.34	3.34
SENE	4.20	4.08

¹ A weight of evidence analysis consists of complementary analyses which use different data sources or methods to support a singular conclusion. Additional information is available in EPA's modeling guidance (EPA-454/B-07-002).

² The Minnesota modeling is also referred to as the 'Minnesota/MRPO' modeling to credit both organizations.

The CENRAP and MRPO 2002 basecase simulations yield similar values for the visibility impairment at the Northern Midwest Class I areas attributable to Iowa sources (see Tables 11.2 and 11.4). The CENRAP 2018 source apportionment simulations yield a slight decrease in Iowa's absolute contribution at all four Northern Midwest Class I areas despite the use of IPM v2.1.9 and the associated higher than anticipated SO₂ emission rates (see Table 11.2). The predicted NO_x reductions are predominantly responsible for the lower contributions modeled by CENRAP. The Minnesota/MRPO 2018 results yield a different trend, as Iowa contributions remain fairly constant between 2002 and 2018 (see Table 11.4), even though the significant reductions from Iowa EGU sources predicted by IPM v3.0 were incorporated in the Minnesota/MRPO modeling. A determination of the exact causes of the inter-project variability would require detailed analyses incommensurate with Iowa's level of contribution. Alternatively, the Minnesota/MRPO results reinforce a known consequence of the non-linear chemistry associated with visibility impairment, in which contributions to visibility impairment attributable to distant emissions sources are highly dependent upon downwind conditions and emissions nearer the affected area.

The CENRAP and Minnesota/MRPO modeling substantiate that Iowa sources can not effect visibility improvement at the Northern Midwest Class I areas without disproportionate and costly levels of control. Results in the preceding paragraphs provides evidence in support of this conclusion. The Department's conclusion is further supported through the following discussion.

The CENRAP modeling utilized EGU emissions forecasts from IPM v2.1.9. The Minnesota/MRPO modeling runs were completed independent of the CENRAP results and were conducted in a later timeframe. Minnesota/MRPO was thus able to use the updated IPM v3.0 modeling predictions. The 2018 SO₂ emissions from Iowa EGUs predicted by IPM v3.0 were approximately 30,000 tpy lower than IPM v2.1.9 forecasts. While the Minnesota/MRPO non-EGU SO₂ emissions may be higher than CENRAP values, any discrepancies remain well below the level of reductions predicted by IPM v3.0. Additionally, the impacts of disparities between non-EGU emissions forecasts are minimal as the MRPO PSAT results show that Iowa's non-EGU sources yield even less influence over visibility impairment at the Northern Midwest Class I areas than EGU sources (see Appendix 11.1).

Table 11.4 shows that the Minnesota/MRPO modeling predicts Iowa's contributions to visibility impairment in 2018 will be in the 2 Mm⁻¹ range. This result is similar to the CENRAP modeling, despite having accounted for additional SO₂ EGU reductions captured in IPM v3.0. Only slight variations (less than ~0.4 Mm⁻¹) in Iowa's contributions to visibility impairment in 2018 at the Minnesota Class I areas is seen when comparing the CENRAP and Minnesota/MRPO regional modeling runs, despite the 30,000 tpy variation among the predicted EGU SO₂ emissions. Summarizing the results, the Minnesota modeling shows little impact on visibility improvement at the Minnesota Class I areas despite EGU SO₂ reductions of ~20,000 tons per year (compared to 2002 conditions). This result is not unexpected, but is a consequence of extensive transport distances combined with the relatively small visibility impairment attributable to Iowa sources. This information substantiates that Iowa sources can not effect visibility improvement at the Northern Midwest Class I areas without disproportionate and costly levels of control.

11.4 Basis for emissions reduction obligations

IDNR is required to document the technical basis for the State's apportionment of emissions reductions necessary to meet the RPG for each Class I area affected by the State's emissions (40 CFR § 51.308(d)(3)(iii)).

IDNR relied on technical analyses developed by CENRAP and the assessments provided in this chapter to demonstrate that Iowa's emissions reductions will be commensurate with the contributions from emissions sources in Iowa. The CENRAP analyses are described in detail in Appendix 7.1. Additional information and analyses, such as the weight of evidence products described in Section 11.3 and the Four Factor Report reference in Chapter 10, were supported through data products developed by the MRPO and Minnesota.

11.5 Baseline inventory

IDNR is required to identify the baseline inventory on which the long-term strategy is based. IDNR used the 2002 CENRAP inventory version BaseG as its baseline inventory (40 CFR § 51.308(d)(3)(iii)). Additional information can be found in Chapter 7 and Appendix 7.1 (see Chapter 2).

11.6 Anthropogenic sources of visibility impairment

IDNR is required to identify all anthropogenic sources of visibility impairment considered by the State in developing its long-term strategy (40 CFR § 51.308(d)(3)(iv)). Appendix 7.1 (see Chapter 2) provides the details of the 2002 emissions inventory used in developing this SIP revision.

11.7 Factors the State Must Consider

IDNR is required to consider several factors in developing its long-term strategy (40 CFR § 51.308(d)(3)(v)). These factors are discussed below.

Emission reductions due to ongoing mandated air pollution control programs.

IDNR is required to consider emission reductions from ongoing pollution control programs (40 CFR § 51.308(d)(3)(v)(A)). IDNR considered the minor and major new source review programs (NSR), prevention of significant deterioration permits (PSD), CAIR, , heavy duty highway diesel rule, clean air non-road diesel rule, other on-road and non-road mobile source programs, operating permits, pertinent new source performance standards (NSPS), national emissions standards for hazardous air pollutants (NESHAP), associated maximum achievable control technology (MACT) standards, and IPM results in developing its long-term strategy. Reductions associated with these programs assist with achieving Iowa's share of emissions reductions, as discussed above in Section 11.2.

The District of Columbia Circuit Court vacated the ICI Boiler NESHAP and Commercial/Industrial Solid Waste Incinerator (CISWI) NSPS on July 30, 2007. The court directed EPA to vacate both rules and to take further action consistent with the court's opinion. The 2018 emissions projections included the ICI Boiler NESHAP and the CISWI NSPS

reductions in the future modeling scenarios. The court action will likely result in more emissions reductions and will define the schedule for the new rules.

The Iowa Bus Emission Education Program (BEEP) is a collaborative effort to reduce childhood exposure to harmful diesel exhaust. The Union of Concerned Scientists ranked Iowa's buses among the dirtiest 20 percent nationally. To improve the state's fleet, BEEP applied for and received funding from EPA's Clean School Bus USA program. BEEP partners include the School Administrators of Iowa, the Iowa Association of School Boards, the IDNR, the Iowa Department of Education, and the Iowa Pupil Transportation Association.

As of October 2007 BEEP has installed 548 diesel oxidation catalysts (DOC) in school districts around the state. Based on communication with school transportation directors, BEEP believes that all school districts wanting DOCs have received them. Essentially, almost all school buses eligible for a DOC have received one in the State of Iowa. According to the data from EPA's verification, each DOC reduces particulate matter air emissions by 20%, carbon monoxide emissions by 40%, and hydrocarbon emissions by 50%.

Biodiesel also was offered to school districts in an effort to promote its use. Based on informal comments and surveys from the school districts involved, biodiesel has been accepted as an alternative fuel. Many comments indicated that it can be difficult to acquire biodiesel higher than a 2% blend. Given the continued interest in alternative fuel production in Iowa, school districts are optimistic that higher grades will be available in the future. BEEP also received a supplement environmental project (SEP) to partially fund two hybrid electric buses. The two buses will be in use by the end of 2007.

BEEP applied for another EPA Clean School Buses grant in September 2007. The grant will request funds to replace the oldest and dirtiest diesel buses.

Measures to mitigate the impacts of construction activities.

The IDNR is required to consider measures to mitigate the impacts of construction activities (40 CFR § 51.308(d)(3)(v)(B)). IDNR's rules on fugitive dust (567 IAC 23.3(2)“c”) state that reasonable precautions shall be taken to prevent the discharge of visible emissions of airborne dust beyond the lot line of the property from which the emissions originated. IDNR also requires minor NSR permits for aggregate processing plants, concrete batch plants, and asphalt plants. Portable aggregate, concrete, or asphalt plants must notify the IDNR 30 days prior to transferring the equipment to a new location to allow for review of the emissions impacts on national ambient air quality standards (NAAQS). The IDNR would notify the portable plant if there are potential adverse impacts on the NAAQS. A more stringent emission standard and the installation of additional control equipment would be required if the relocation would prevent the attainment or maintenance of the NAAQS. IDNR determined that no additional measures were needed to mitigate the impacts of construction activities. General construction activities will not impact Class I area visibility due to the extensive transport distance in combination with the relatively low emissions and release heights.

Emissions limitations and schedules of compliance.

IDNR is required to identify additional measures to meet RPGs when ongoing programs alone are not sufficient to meet the goals (40 CFR § 51.308(d)(3)(v)(C)). IDNR found that ongoing air pollution control programs were sufficient to meet anticipated RPGs through 2018.

Source retirement and replacement schedules

IDNR is required to consider source retirement and replacement schedules in developing RPGs (40 CFR § 51.308(d)(3)(v)(D)). Retirement and replacement will be managed in conformance with existing SIP requirements pertaining to PSD and NSR. IDNR updated the IPM inputs for the version 2.1.9 and 3.0 runs to include permit revisions and operating characteristics. The IPM results include new and retired units.

New plants not predicted by IPM v3.0

There is one proposed new coal-fired EGU and one additional coal-fired EGU being contemplated in Iowa. It is premature to address potential emissions from either facility. Updates on new or proposed plants, and any significant growth of emissions from existing plants, will be included in the progress report due five-years after the initial SIP submittal.

Agricultural and forestry smoke management

IDNR is required to consider smoke management techniques for the purposes of agricultural and forestry management in developing the long-term strategy (40 CFR § 51.308(d)(3)(v)(E)). IDNR, at this time, has not adopted a smoke management program. The CENRAP PSAT modeling indicates that fires in Iowa do not significantly contribute to visibility impairment in mandatory Class I Federal areas. Therefore, there is no need for a smoke management plan (SMP) in this SIP revision.

IDNR has been working on developing aspects of a statewide SMP for several years. Iowa currently burns less than 25,000 acres per year, which is considerably less than most other states.

Prior to developing a statewide SMP for all prescribed burning, IDNR is developing a fire policy. This policy will specify how IDNR conducts prescribed burning on state, federal, and private lands for which the agency has management authority. Smoke management will be an important part of this policy.

Upon completion of the fire policy, IDNR intends to begin working on air quality rules for prescribed natural resource burning. These rules will require a written burn plan, and will also require smoke management consistent with the fire policy. IDNR will work with stakeholders, such as Nature Conservancy, National Resource Conservation Service, and other prescribed burners to develop a SMP. The stakeholders have already formed an Iowa Fire Council with a smoke management committee. This committee will work with the IDNR to develop an Iowa SMP.

It is expected that the Iowa SMP will be completed late in 2008. It will substantially comply with the guidelines set forth in EPA's Interim Air Quality Policy and Prescribed and Wildland

Fire (1998). However, EPA is currently working with stakeholders to revise this policy to make it consistent with the Exceptional Events rule. IDNR staff is participating in meetings discussing the policy revisions.

Enforceability of emissions limitations and control measures

IDNR is required to ensure that emissions limitations and control measures used to meet RPGs are enforceable (40 CFR § 51.308(d)(3)(v)(F)).

IDNR's program ensures that all measures used to meet anticipated RPGs are enforceable by embodying these in administrative orders, permits, and the Iowa Administrative Code.

Anticipated net effect on visibility resulting from projected changes to emissions

IDNR is required to address the net effect on visibility resulting from changes projected in point, area and mobile source emissions by 2018 (40 CFR § 51.308(d)(3)(v)(G)).

The emissions inventory for Iowa projects changes to point, area and mobile source inventories by the end of the first implementation period resulting from population growth, industrial, energy and natural resources development, land management, and air pollution control. A review of these changes is discussed in Chapter 7 for each of the pollutants addressed in the regional haze inventory. Greater detail is provided in Appendix 7.1

As indicated above, IDNR considered NSR, CAIR, heavy duty highway diesel rule, clean air non-road diesel rule, other on-road and non-road mobile source programs, operating permits, pertinent NSPS, NESHAP, associated MACT standards, and IPM results in developing its long-term strategy.

List of Chapter 11 Appendices

- 11.1 Regional Air Quality Analyses for Ozone, PM_{2.5}, and Regional Haze: Technical Support Document. States of Illinois, Indiana, Michigan, Ohio, and Wisconsin. February 15th, 2008.

12. Comprehensive Periodic Implementation Plan Revisions

Forty CFR § 51.308(f) requires a State/Tribe to revise its regional haze implementation plan and submit a plan revision to EPA by July 31, 2018, and every ten (10) years thereafter. In accordance with the requirements listed in 40 CFR § 51.308(f) of the federal rule for regional haze, IDNR commits to revising and submitting this regional haze implementation plan by July 31, 2018, and every ten (10) years thereafter.

In addition, 40 CFR § 51.308(g) requires periodic reports evaluating progress towards the RPG established for each mandatory Class I Federal area outside the state which may be affected by emissions from within the State. In accordance with the requirements listed in 40 CFR § 51.308(g) of the federal rule for regional haze, IDNR commits to submitting a report on reasonable progress to EPA every five years following the initial submittal of the SIP. All requirements listed in 51.308(g) shall be addressed in the SIP revision for reasonable progress, including a review of the changes in the emission inventory, a review of the periodic reporting requirements, and a determination of whether additional action is needed according to § 51.308(h). The Department commits to submitting the required five year SIP revision by December 17, 2012.

List of Chapter 12 Appendices

There are no Appendices to Chapter 12.

13. Determination of the Adequacy of the Existing Plan for the Purposes of the Five-Year Progress Report

The IDNR has determined the SIP to be adequate. Depending on the findings of the five-year progress report, IDNR commits to taking one of the actions listed in 40 CFR § 51.308(h). The findings of the five-year progress report will determine which action is appropriate and necessary.

List of Possible Actions – 40 CFR § 51.308(h)

- 1) IDNR determined that the existing SIP required no further substantive revision in order to achieve established goals. IDNR provided to the Administrator a negative declaration that further revision of the SIP is not needed at this time.
- 2) IDNR determined that the existing SIP may be inadequate to ensure reasonable progress due to emissions from other states which participated in the regional planning process. IDNR provided notification to the Administrator and the states that participated in regional planning. IDNR collaborated with states through the regional planning process to address the SIP's deficiencies.
- 3) IDNR determined that the current SIP may be inadequate to ensure reasonable progress due to emissions from another country. IDNR provided notification, along with available information, to the Administrator.
- 4) IDNR determined that the existing SIP is inadequate to ensure reasonable progress due to emissions within the State of Iowa. IDNR will revise/has revised its SIP to address the plan's deficiencies. {State/Tribe must address the deficiencies within one year.}

List of Chapter 13 Appendices

There are no Appendices to Chapter 13.

Guidance Documents

Consolidated Emissions Reporting Rule. June 10, 2002, 67 FR 39602-39616,
<http://www.epa.gov/ttn/chief/cerr/cerr.pdf>.

Controlling SO₂ Emissions: A Review of Technologies, EPA-600/R-00-093. November 2000.
EPA Office of Research and Development.

Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations, EPA-454/R-05-001. August 2005. <http://www.epa.gov/ttn/chief/eidocs/eiguid/index.html>.

EPA Clean Air Technology Center - Control Cost Manual (5th edition).
<http://www.epa.gov/ttn/catc/products.html>.

EPA Guidelines for Preparing Economic Analyses. <http://www.epa.gov/economics/>.

Guidance for Improving Weight of Evidence Through Identification of Additional Emission Reductions, Not Modeled.
<http://www.epa.gov/scram001/guidance/guide/addwoe1h.wpd>.

Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program. June 1, 2007. http://www.epa.gov/ttn/oarpg/t1/memoranda/reasonable_progress_guid071307.pdf.

Guidance for Tracking Progress under the Regional Haze Rule, EPA-454/B-03-004. September 2003. http://www.epa.gov/ttncaaa1/t1/memoranda/rh_tpurhr_gd.pdf.

Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM_{2.5} and Regional Haze, EPA-454/B-07-002. April 2007.
<http://www.epa.gov/ttn/scram/guidance/guide/final-03-pm-rh-guidance.pdf>

Guidelines for Determining Best Available Retrofit Technology for Coal-fired Power Plants and Other Existing Stationary Facilities, EPA-450/3-80-009b. November 1980.

Guidelines for Determining Natural Background.
http://www.epa.gov/ttncaaa1/t1/memoranda/rh_envcurhr_gd.pdf

IMPROVE Particulate Monitoring Network - Procedures for Site Selection. Crocker Nuclear Laboratory, University of California, February 24, 1999.
<http://www.epa.gov/ttn/amtic/files/ambient/visible/select22.pdf>

IMPROVE Particulate Monitoring Network – Standard Operating Procedures Air Quality. Crocker Nuclear Laboratory, University of California, October 15, 1998.
<http://www2.nature.nps.gov/ard/vis/sop/index.html>

Improving Air Quality with Economic Incentive Programs, EPA-452/R-01-001. January 2001. <http://www.epa.gov/ttn/oarpg/t1/memoranda/eipfin.pdf>

National Park Service Visibility Monitoring internet site.
<http://www2.nature.nps.gov/ard/vis/vishp.html>

Reasonable Progress for Class I Areas in the Northern Midwest – Factor Analysis. EC/R Incorporated for LADCO and MPCA. http://ladco.org/MRPO%20Report_071807.pdf

Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations. July 6, 2005, 70 FR 39104 – 39172. <http://www.epa.gov/EPA-AIR/2005/July/Day-06/a12526.htm>

Regional Haze Regulations; Final Rule. July 1, 1999, Federal Register 64 FR 35714 – 35774, <http://www.epa.gov/EPA-AIR/1999/July/Day-01/a13941.htm>,
http://www.epa.gov/ttn/oarpg/t1/fr_notices/rhfedreg.pdf.

Technical Memorandum (Final): Methods for Evaluating Statutory Factors. MACTEC Project 827007G184 for MARMA.
http://www.marama.org/visibility/RPG/EvaluationMethods_TM2/RPG_EvaluationMethods_TM2%20Final_020607.pdf

Visibility Monitoring Guidance document, EPA-454/R-99-003. June 1999.
<http://www.epa.gov/ttn/amtic/files/ambient/visible/r-99-003.pdf>

Voluntary Emissions Reduction Program for Major Industrial Sources of Sulfur Dioxide in Nine Western States and a Backstop Market Trading Program. An Annex to the Report of the Grand Canyon Visibility Transport Commission. Western Regional Air Partnership. September 29, 2000.
http://www.wrapair.org/forums/mtf/documents/group_reports/ANNEX/execsum082800.pdf